Response to EPA's Second Round of Comments on the Draft Ecological Risk Assessment for Harbor Oil (received January 29, 2010)

General Comment 1: Please revise the text and direct readers/reviewers to these tables so that readers/reviewers do not have to "hunt" for such information. In addition, all data files have a column entitled "value or half DL", if ProUCL version 4.00.04 was used and non-detect values were not needed to adjust to half detection limit, then values in this column are incorrect. Please make all necessary changes.

> ***VG Response****: The "value or half DL" column was not used in ProUCL when calculating UCLs. This will be clarified with a footnote in the revised tables.*

General Comment 2: Ideally the VG should use TRVs developed for the Portland Harbor Baseline Ecological Risk Assessment as much as possible. These TRVs have been approved by the EPA and are applicable to the Harbor Oil site. If the VG chooses to use other TRVs, please provide a discussion of any differences in the TRVs and what the significance of those differences would have.

> ***VG Response****: As discussed in the call on 02/03/10, the VG does not recommend using Portland Harbor TRVs for use in the Harbor Oil ERA because different selection criteria and/or selection processes were used to select Portland Harbor TRVs. For example, some bird and mammal dietary TRVs for Portland Harbor were based on soil screening values rather than based on the primary literature and some fish tissue TRVs were based on field studies.*

General Comment 5: Indicate whether site conditions have changed since the 1997 City of Portland Natural Resource Management Plan, and if so, how that effects the ecological setting.

> ***VG Response****: Text will be added to ERA indicating that the overall site conditions do not appear to have changed since the 1997 City of Portland National Resource Management Plan.*

General Comment 6: The Voluntary Group response cites the Conceptual Site Model or the Risk Scoping Memorandum as reasons for why only invertebrate soil screening levels are appropriate for direct contact and that other receptors were evaluated by a dietary approach for ingestion of soils. This results in use of SSLs that are not protective of numerous receptors and use of the dietary approach without also using a food chain model to address bioaccumulative chemicals. Risk Assessments are an iterative process and must evaluate the lines of evidence (data) which may indicate a risk, or potential risk from a release. The exclusion of amphibians, avians, mammals and plants from the BERA on the basis that the Scoping Memorandum or CSM does not support their inclusion is inappropriate, especially when there are screening values available that are being exceeded at the study area. This results in an increase of uncertainty for making risk management decisions, which at this stage is inappropriate. The VG responded to a comment EPA submitted (comment 9) on the "Phase 2 Sampling, Harbor Oil NPL Site on January 6, 2009" that: "*The pathways identified as either complete and significant (CP – S) or complete and significance unknown (CP – U) will be quantitatively evaluated as*

part of the BERA, and are shaded gray in the above table (Table attached). *While pathways identified as complete and significance unknown may not be an important contributor to the risk for that receptor, the analysis of this pathway will ensure that the BERA is conservative."* EPA expects the BERA to contain a quantitative evaluation of all the COPCs which exceed any SSL for any receptors potentially exposed at the site.

VG Response*: As discussed in the call on 02/03/10, the VG disagrees with screening COPCs by media, rather than on a receptor-specific basis. The Harbor Oil COPC screening process followed the ecological CSM for evaluating each of the exposure pathways. Flowcharts of the COPC selection process have been created to show the COPC screening process implemented by the VG in the ERA; these flow charts have been added to the ERA. The accumulation of soil into the uptake exposure pathway for birds and mammals is accounted for in the screening of soil COIs through the dietary model. The entire COPC screen section has been redrafted for clarity and the revised COPC screening text (Section 2.6 of the ERA) is provided as Attachment 1.*

General Comment 8: ProUCL output data sets were spot checked and appear to be correct. However, data files provided by VG have a column entitled "value or half DL", it is not clear why half DL was listed as data input for 95%UCL calculations since ProUCL version 4.00.04 was employed. Please clarify or make necessary corrections.

VG Response*: The "value or half DL" column was not used in ProUCL when calculating UCLs. This will be clarified with a footnote in the revised tables.*

General Comment 9: EPA's comment was whether or not sediment concentrations or sediment criteria were normalized during the screening process and not the estimated tissue concentrations. Please indicate whether sample specific TOC was used to adjust concentrations of sediment or sediment criteria for organic chemicals.

VG Response*: As discussed on the 02/03/10 call between VG and EPA, sediment criteria (i.e., TECs/TELs and PECs/PELs) are not presented on a TOC-normalized basis (they are presented in dw). Therefore, sample-specific TOC normalization was not done to adjust sediment or sediment criteria.*

General Comment 10: As EPA commented earlier, concentrations for organics should be normalized for site-specific TOC and then compared to PELs/PECs. In addition, use of a quantitative measurement endpoint such as conducting bioassays as opposed to using qualitative methods would be more appropriate at this stage in the risk assessment process. Using bioassays would provide a much stronger line of evidence in the BERA. Conducting the quantitative evaluation of sediments and soils may address the need for conducting bioassays for both effects on invertebrates and for food web modeling for other receptors.

VG Response*: As discussed on the 02/03/10 call between VG and EPA, sediment criteria (i.e., TECs/TELs and PECs/PELs) are not presented on a TOC-normalized basis (they are presented in dw). Therefore, sample-specific TOC normalization was not done to adjust sediment or sediment criteria.*

As discussed previously, based on the comparison of sediment concentrations to PELs and PECs, the potential for toxicity to benthic invertebrates is expected to be low and the need for

bioassays is not warranted. Concentrations of metals, PAHs, and PCBs were all less than PELs or PECs. DDD and DDE concentrations were greater than PEL/PECs, although total DDT concentrations were not. It is important to note that PELs and PECs have a dry weight basis (i.e., they are not carbon normalized). Because the surface sediment in Force Lake has a high TOC content (1.34% to 13.1%, with an average of 7.1%), the decreased bioavailability in Force Lake due to partitioning to TOC is not accounted for and would significantly reduce the potential for effects.

Specific Comment 11: Please clarify what minimum reporting limit means. Is it the lower or lowest RLs among duplicate samples? If so, for conservative purposes, the higher RL, and not the lower RL, should be used.

***VG Response**: As discussed on the 02/03/10 call between VG and EPA, clarifying language will be provided in the text of the revised ERA. No changes to data will be made.*

Specific Comment 13 (first part): As noted earlier, this is not acceptable. It is true that it is very common for risk assessments to have to acknowledge that toxicity information is not available for some chemicals. However, limiting exposure pathways to a particular receptor (e.g, invertebrate only) is not commonly used in risk assessments, and EPA does not approve of it for this risk assessment.

***VG Response**: Please see previous response to General Comment #6.*

Specific Comment 13 (second part): As noted earlier, using screening levels that are only limited to invertebrate screening levels for terrestrial receptors is not acceptable. As EPA comment noted, the lowest screening level among screening levels for all soil receptors (i.e., invertebrates, plants, birds, and mammals) should be used for screening.

***VG Response**: Please see previous response to General Comment #6. All receptors were screened (not just invertebrates).*

Specific Comment 30a: VG should list range of concentrations that are used for calculating HQ range in this table.

***VG Response**: Requested change will be made in the revised ERA.*

Specific Comment 38: VG should list range of concentrations that are used for calculating HQ range in this table.

***VG Response**: Requested change will be made in the revised ERA.*

Specific Comment 43b: It is still unclear where the levels of 7.5 and 2.5 ppb, respectively, for total DDT and DDE listed in Table 1 in Appendix C come from.

***VG Response**: As discussed on the 02/03/10 call, this same background level was reported in Appendix G of the HHRA and the footnote included in Appendix G of the HHRA will be added to the ERA to clarify that these low range background values are based on one-half of the reporting limit from the Radio Tower study.*

ATTACHMENT 1: ERA COPC SCREENING TEXT (SECTION 2.6 OF THE ERA)

2.6 COPC Screen

A risk-based screen was conducted for each ROC to identify a list of COPCs that may cause adverse effects; these COPCs are further assessed in the ERA. The COPC screen was conducted in accordance with the methods outlined in the RI/FS Work Plan (Bridgewater et al. 2008) and Risk Assessment Scoping Memorandum (Windward and Bridgewater 2008). COPCs were determined separately for aquatic benthic invertebrates, terrestrial invertebrates, fish ROCs, bird ROCs, and mammal ROCs, as discussed below.

2.6.1 Aquatic Benthic Invertebrates

This section presents the COPC screen for aquatic benthic invertebrates, which is summarized in Figure 2-4.

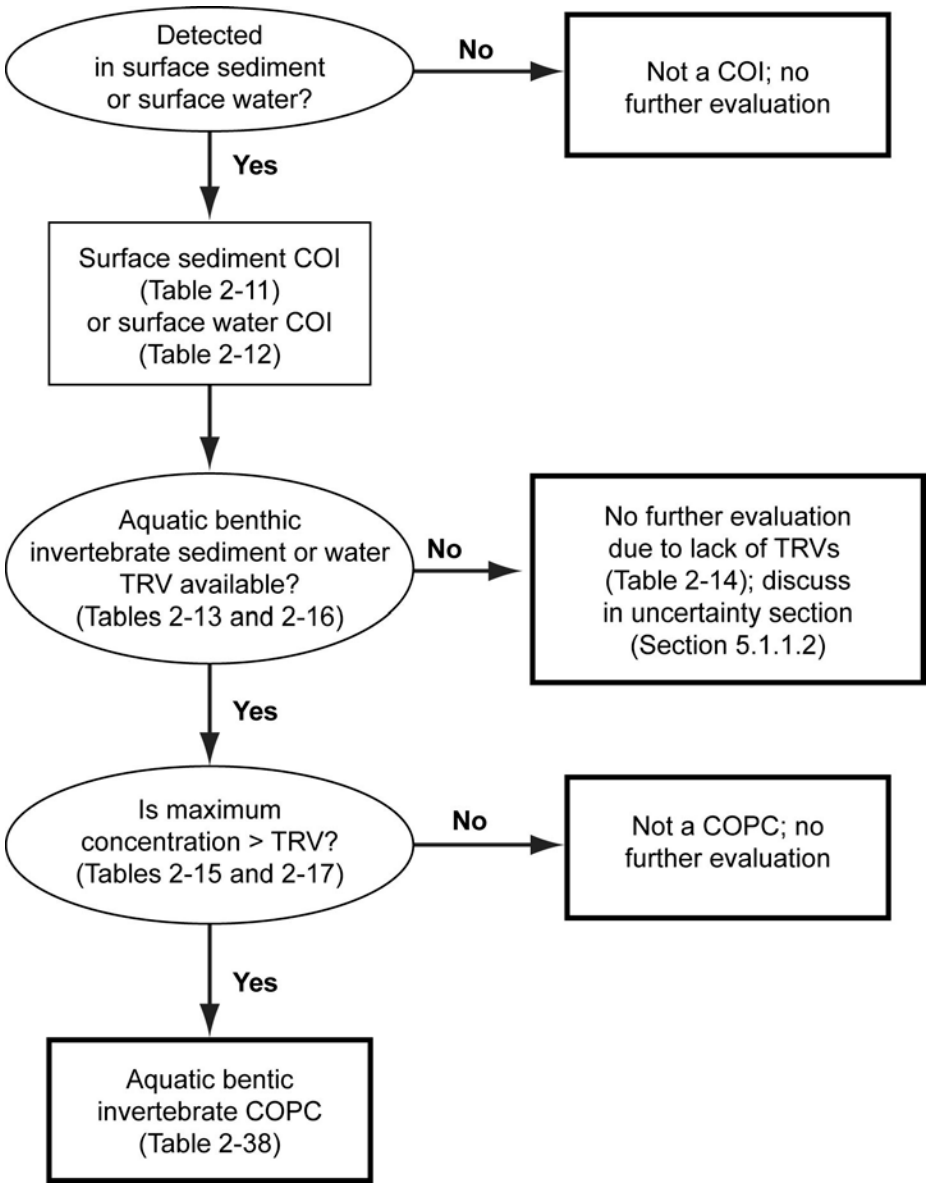

Figure 2-4. COPC Screening Process for Aquatic Benthic Invertebrates

2.6.1.1 COIs for Aquatic Benthic Invertebrates

The first step of the COPC screening process for aquatic benthic invertebrates was to generate a list of chemicals of interest (COIs). Surface sediment and surface water COIs for aquatic benthic invertebrates were defined as any analyte detected in at least one sample in a given media (e.g., an analyte detected in sediment was a sediment COI).

Tables 2-11 and 2-12 present the surface sediment and surface water COIs. These COIs are screened in Sections 2.6.1.2 and 2.6.1.3 to identify COPCs for aquatic benthic invertebrates.

Table 2-11. Chemicals Detected in Surface Sediment and Thus Identified as COIs

Surface Sediment COI	
Metals	
Arsenic	Lead
Barium	Mercury
Cadmium	Nickel
Chromium	Vanadium
Cobalt	Zinc
Copper	
PAHs	
2-Methylnaphthalene	Dibenzo(a,h)anthracene
Acenaphthene	Dibenzofuran
Acenaphthylene	Fluoranthene
Anthracene	Fluorene
Benzo(a)anthracene	Indeno(1,2,3-cd)pyrene
Benzo(a)pyrene	Naphthalene
Benzo(b)fluoranthene	Phenanthrene
Benzo(g,h,i)perylene	Pyrene
Benzo(k)fluoranthene	Total HPAHs
Total benzofluoranthenes	Total LPAHs
Chrysene	Total PAHs
PCBs	
Aroclor 1254	Total PCBs
Aroclor 1260	
Pesticides	
2,4′-DDD	4,4′-DDE
4,4′-DDD	Total DDTs
VOCs	
Acetone	Methyl ethyl ketone
Carbon disulfide	Toluene
TPH	
TPH-gasoline range	TPH-motor oil range
TPH-diesel range	Total petroleum hydrocarbons

COI – chemical of interest
DDD – dichlorodiphenyldichloroethane
DDE – dichlorodiphenyldichloroethylene
DDT – dichlorodiphenyltrichloroethane
HPAH – high-molecular-weight polycyclic aromatic hydrocarbon
LPAH – low-molecular-weight polycyclic aromatic hydrocarbon
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
SVOC – semivolatile organic compound
TPH – total petroleum hydrocarbons
VOC – volatile organic compound

Table 2-12. Chemicals Detected in Surface Water and Thus Identified as COIs

Surface Water COI	
Metals	
Arsenic	Copper
Barium	
VOCs	
Acetone	

COI – chemical of interest
VOC – volatile organic compound

2.6.1.2 Surface Sediment COPC Screen for Aquatic Benthic Invertebrates

In the second step, COPCs for aquatic benthic invertebrates in surface sediment were identified by comparing maximum detected COI concentrations in surface sediment to aquatic benthic invertebrate-specific sediment screening thresholds. COIs with maximum detected concentrations greater than screening thresholds were considered COPCs for aquatic benthic invertebrates. Sediment screening thresholds protective of aquatic benthic invertebrates were selected as the lowest of the following thresholds:

- Threshold effects levels (TELs) reported by Smith et al. (1996)
- Threshold effects concentrations (TECs) reported by MacDonald et al. (2000)

The lowest sediment screening threshold for each COI is presented in Table 2-13. Appendix A provides a table of all sediment thresholds compiled from the above sources. Sediment COIs with no screening thresholds are presented in Table 2-14; these chemicals were not addressed further in the ERA but are noted in the uncertainty analysis.

Table 2-13. Aquatic Benthic Invertebrate Sediment Screening Thresholds

Surface Sediment COI	Screening Threshold	Unit (dw)	Source
Metals			
Arsenic	5.9	mg/kg	Smith et al. (1996)
Cadmium	0.596	mg/kg	Smith et al. (1996)
Chromium	37.3	mg/kg	Smith et al. (1996)
Copper	31.6	mg/kg	MacDonald et al. (2000)
Lead	35	mg/kg	Smith et al. (1996)
Mercury	0.174	mg/kg	Smith et al. (1996)
Nickel	18	mg/kg	Smith et al. (1996)
Zinc	121	mg/kg	MacDonald et al. (2000)
PAHs			
Anthracene	57.2	µg/kg	MacDonald et al. (2000)
Benzo(a)anthracene	31.7	µg/kg	Smith et al. (1996)

Table 2-13. Aquatic Benthic Invertebrate Sediment Screening Thresholds

Surface Sediment COI	Screening Threshold	Unit (dw)	Source
Benzo(a)pyrene	31.9	µg/kg	Smith et al. (1996)
Chrysene	57.1	µg/kg	Smith et al. (1996)
Dibenzo(a,h)anthracene	33	µg/kg	MacDonald et al. (2000)
Fluoranthene	111	µg/kg	Smith et al. (1996)
Fluorene	77.4	µg/kg	MacDonald et al. (2000)
Naphthalene	176	µg/kg	MacDonald et al. (2000)
Phenanthrene	41.9	µg/kg	Smith et al. (1996)
Pyrene	53	µg/kg	Smith et al. (1996)
Total PAHs[a]	1,610	µg/kg	MacDonald et al. (2000)
PCBs			
Total PCBs[b]	34.1	µg/kg	Smith et al. (1996)
Pesticides			
2,4′-DDD	3.54	µg/kg	Smith et al. (1996)
4,4′-DDD	3.54	µg/kg	Smith et al. (1996)
4,4′-DDE	1.42	µg/kg	Smith et al. (1996)
Total DDTs	5.28	µg/kg	MacDonald et al. (2000)

[a] Individual PAH COIs listed in Table 2-11 (acenaphthylene, acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, total benzofluoranthenes [benzo(b)fluoranthene and benzo(k)fluoranthene], benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, indeno(1,2,3,-c,d)pyrene, fluoranthene, fluorene, naphthalene, phenanthrene, and pyrene) were evaluated as part of the total PAH sum.

[b] Individual PCB Aroclor COIs listed in Table 2-11 (Aroclor 1254 and Aroclor 1260) were evaluated as part of the total PCB sum.

COI – chemical of interest
DDD – dichlorodiphenyldichloroethane
DDE – dichlorodiphenyldichloroethylene
DDT – dichlorodiphenyltrichloroethane
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl

Table 2-14. COIs with No Aquatic Benthic Invertebrate Screening Threshold

Surface Sediment COI	
Metals	
Barium	Vanadium
Cobalt	
PAHs	
2-Methylnaphthalene	Dibenzofuran
VOCs	
Acetone	Methyl ethyl ketone
Carbon disulfide	Toluene
TPH	
TPH-gasoline range	TPH-motor oil range
TPH-diesel range	Total petroleum hydrocarbons

COI – chemical of interest
PAH – polycyclic aromatic hydrocarbon
TPH – total petroleum hydrocarbons
VOC – volatile organic compound

Table 2-15 presents the results of the surface sediment screen for aquatic benthic invertebrates. Eighteen COPCs (i.e., arsenic, cadmium, copper, lead, mercury, nickel, zinc, benzo(a)anthracene, benzo(a)pyrene, chrysene, fluoranthene, phenanthrene, pyrene, total PCBs, 2,4′-DDD, 4,4′-DDD, 4,4′-DDE, and total DDTs) were identified because maximum surface sediment concentrations were greater than the lowest sediment screening thresholds. These COPCs are evaluated further in the aquatic benthic invertebrate risk assessment (Section 5.1.1).

Table 2-15. Aquatic Benthic Invertebrate COPC Screen Results for Surface Sediment

Surface Sediment COI	Unit (dw)	Maximum Concentration	Screening Threshold	COPC?
Metals				
Arsenic	mg/kg	7	5.9	**yes**
Cadmium	mg/kg	2	0.596	**yes**
Chromium	mg/kg	34	37.3	no
Copper	mg/kg	72	31.6	**yes**
Lead	mg/kg	56	35	**yes**
Mercury	mg/kg	0.2	0.174	**yes**
Nickel	mg/kg	31	18	**yes**
Zinc	mg/kg	229	121	**yes**
PAHs				
Anthracene	µg/kg	26	57.2	no
Benzo(a)anthracene	µg/kg	74	31.7	**yes**
Benzo(a)pyrene	µg/kg	83	31.9	**yes**
Chrysene	µg/kg	110	57.1	**yes**
Dibenzo(a,h)anthracene	µg/kg	6.5	33	no
Fluoranthene	µg/kg	190	111	**yes**
Fluorene	µg/kg	26	77.4	no
Naphthalene	µg/kg	61	176	no
Phenanthrene	µg/kg	120	41.9	**yes**
Pyrene	µg/kg	180	53	**yes**
Total PAHs	µg/kg	1,060	1,610	no
PCBs				
Total PCBs	µg/kg	131	34.1	**yes**
Pesticides				
2,4′-DDD	µg/kg	61	3.54	**yes**
4,4′-DDD	µg/kg	47	3.54	**yes**
4,4′-DDE	µg/kg	150	1.42	**yes**
Total DDTs	µg/kg	250	5.28	**yes**

COI – chemical of interest
COPC – chemical of potential concern
DDD – dichlorodiphenyldichloroethane
DDE – dichlorodiphenyldichloroethylene
DDT – dichlorodiphenyltrichloroethane
dw – dry weight
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
Bold identifies COPCs.

2.6.1.3 Surface Water COPC Screen for Aquatic Benthic Invertebrates

COPCs for aquatic benthic invertebrates were also determined using surface water data. Surface water COPCs were identified by comparing maximum surface water concentrations to chronic water screening thresholds. Surface water COIs with maximum detected concentrations greater than the water screening thresholds were considered COPCs for aquatic benthic invertebrates.

Chronic water screening thresholds protective of aquatic species (including aquatic invertebrates) were selected based on the lower of national water quality criteria protective of freshwater organisms (EPA ambient water quality criteria [AWQC]) or proposed Oregon water quality criteria (Oregon Administrative Rule [OAR] 340-41, Table 33). For those COIs for which neither AWQC nor Oregon water quality criteria were available, the Tier 2 values provided by Suter and Tsao (1996) were used. Water screening thresholds for surface water COIs are presented in Table 2-16. Appendix A also provides a table of the water thresholds.

Table 2-16. Selected Chronic Water Screening Thresholds

Surface Water COI	Unit	Screening Threshold	Source
Metals			
Arsenic	µg/L	150[a]	EPA AWQC (2009)
Barium	µg/L	4[b]	Tier II (Suter and Tsao 1996)
Copper	µg/L	1.3[a, c]	EPA AWQC (2009)
VOCs			
Acetone	µg/L	1,500	Tier II (Suter and Tsao 1996)

[a] Threshold expressed as the dissolved metal concentration.

[b] Threshold expressed as the total metal concentration.

[c] Threshold was hardness adjusted based on the average Force Lake hardness (10.7 mg/L $CaCO_3$).

AWQC – ambient water quality criteria
COI – chemical of interest
EPA – US Environmental Protection Agency
VOC – volatile organic compound

Table 2-17 presents the results of the surface water screen. Two COPCs (i.e., barium and copper) were identified and are evaluated further in the aquatic benthic invertebrate risk assessment (Section 5.1.1).

Table 2-17. COPC Screen Results for Surface Water

Surface Water COI	Unit	Maximum Concentration	Screening Threshold	COPC?
Metals				
Arsenic (dissolved)	µg/L	1	150	no
Barium (total)	µg/L	31	4	**yes**
Copper (dissolved)	µg/L	4.0	1.3	**yes**
VOCs				
Acetone	µg/L	6.5	1,500	no

COI – chemical of interest
COPC – chemical of potential concern
VOC – volatile organic compound
Bold identifies COPCs.

2.6.2 Terrestrial Invertebrates

This section presents the COPC screen for terrestrial invertebrates, which is summarized in Figure 2-5.

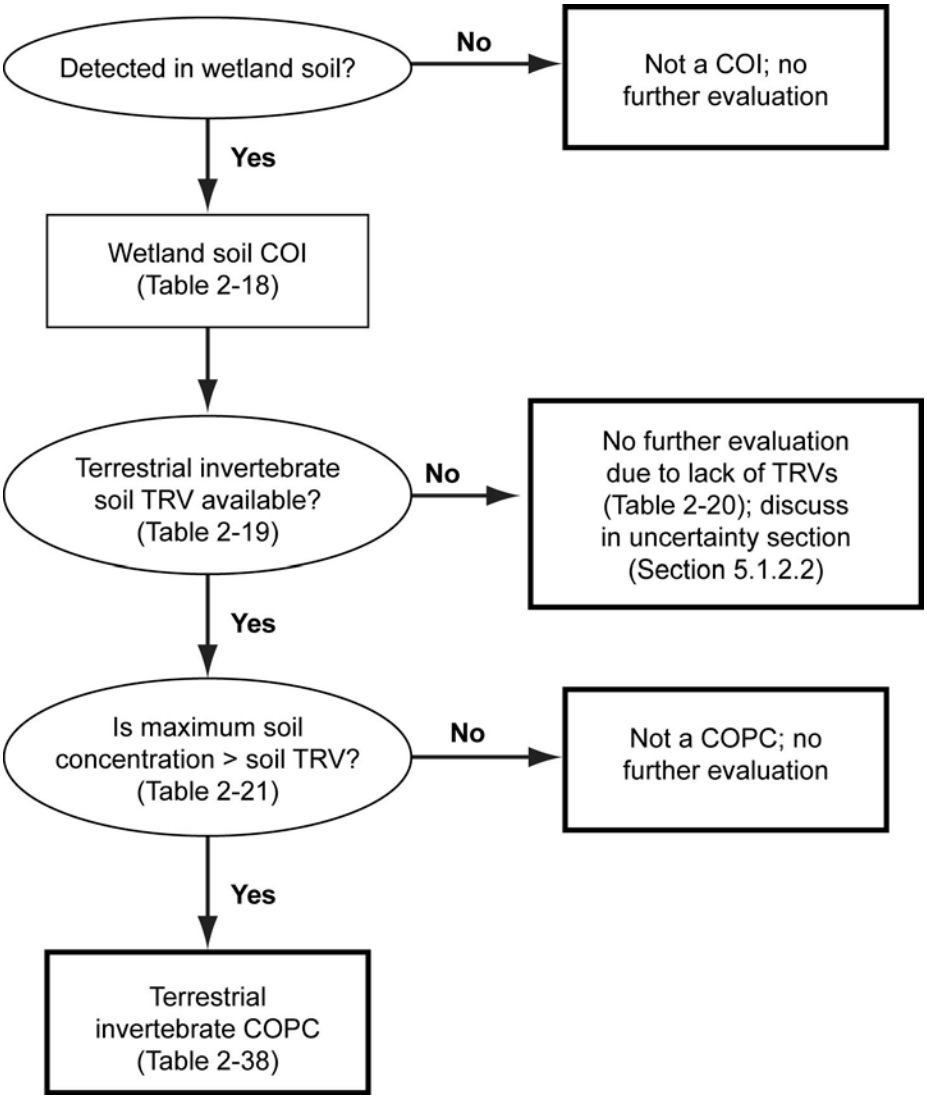

Figure 2-5. COPC Screening Process for Terrestrial Invertebrates

2.6.2.1 COIs for Terrestrial Invertebrates

The first step of the COPC screening process for terrestrial invertebrates was to generate a list of chemicals of interest (COIs). Wetland soil COIs for terrestrial invertebrates were defined as any analyte detected in at least one wetland soil sample. Table 2-18 presents the wetland soil COIs for terrestrial benthic invertebrates.

Table 2-18. Chemicals Detected in Wetland Soil and Thus Identified as COIs

Wetland Soil COI[a]	
Metals	
Aluminum	Lead
Antimony	Manganese
Arsenic	Mercury

Table 2-18. Chemicals Detected in Wetland Soil and Thus Identified as COIs

Wetland Soil COI[a]	
Barium	Nickel
Beryllium	Selenium
Cadmium	Silver
Chromium	Vanadium
Cobalt	Zinc
Copper	
PAHs	
2-Methylnaphthalene	Dibenzo(a,h)anthracene
Acenaphthene	Dibenzofuran
Acenaphthylene	Fluoranthene
Anthracene	Fluorene
Benzo(a)anthracene	Indeno(1,2,3-cd)pyrene
Benzo(a)pyrene	Naphthalene
Benzo(b)fluoranthene	Phenanthrene
Benzo(g,h,i)perylene	Pyrene
Benzo(k)fluoranthene	Total HPAHs
Total benzofluoranthenes	Total LPAHs
Chrysene	Total PAHs
Phthalates	
Bis(2-ethylhexyl) phthalate	Di-n-butyl phthalate
Butyl benzyl phthalate	
Other SVOCs	
1,4-Dichlorobenzene	Biphenyl
4-Methylphenol	Carbazole
Acetophenone	Hexachlorobenzene
Benzaldehyde	Pentachlorophenol
Benzoic acid	Phenol
Benzyl alcohol	
PCBs	
Aroclor 1248	Aroclor 1260
Aroclor 1254	Total PCBs
Pesticides	
2,4′-DDD	4,4′-DDT
2,4′-DDE	Total DDTs
2,4′-DDT	delta-BHC
4,4′-DDD	Methoxychlor
4,4′-DDE	
VOCs	
1,2,4-Trimethylbenzene	Methyl ethyl ketone
Acetone	Methyl isobutyl ketone

Table 2-18. Chemicals Detected in Wetland Soil and Thus Identified as COIs

Wetland Soil COI[a]	
Benzene	Tetrachloroethene
Carbon disulfide	Toluene
cis-1,2-Dichloroethene	Trichloroethene
p-Cymene	o-Xylene
Dichloromethane	m,p-Xylene
Ethylbenzene	Total xylene
TPH	
TPH-gasoline range	TPH-motor oil range (HCID)
TPH-diesel range (HCID)	TPH-motor oil range
TPH-diesel range	Total petroleum hydrocarbons

[a] Calcium, iron, magnesium, potassium, and sodium were detected historically; however, these analytes were not evaluated as COIs because they were not analyzed as part of Phase 1 or Phase 2 sampling events for the RI and are not expected to be toxic to ecological ROCs.

BHC –hexachlorocyclohexane
COI – chemical of interest
DDD – dichlorodiphenyldichloroethane
DDE – dichlorodiphenyldichloroethylene
DDT – dichlorodiphenyltrichloroethane
HCID – hydrocarbon identification
HPAH – high-molecular-weight polycyclic aromatic hydrocarbon
LPAH – low-molecular-weight polycyclic aromatic hydrocarbon
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
RI – remedial investigation
SVOC – semivolatile organic compound
TPH – total petroleum hydrocarbons
VOC – volatile organic compound

2.6.2.2 COPC Screen for Terrestrial Invertebrates

In the second step, COPCs for terrestrial invertebrates were identified in wetland soil by comparing maximum detected COI concentrations in soil to terrestrial invertebrate-specific screening thresholds. COIs with maximum detected concentrations greater than soil screening thresholds were considered COPCs for terrestrial invertebrates. Terrestrial invertebrate-specific soil screening thresholds were selected as the lowest terrestrial invertebrate-specific threshold from the following sources:

- EPA Ecological Soil Screening Levels (SSLs) (2007a) protective of soil invertebrates
- Oak Ridge National Laboratory (ORNL) soil data for invertebrates (Efroymson et al. 1997)
- Oregon Department of Environmental Quality (DEQ) soil screening level values protective of terrestrial invertebrates (2001)

The lowest soil screening threshold for each COI is presented in Table 2-19. Appendix A provides a table of all soil screening values compiled from the above sources. Soil COIs with no screening values are presented in Table 2-20; these chemicals were not addressed further in the ERA but are noted in the uncertainty analysis.

Table 2-19. Terrestrial Invertebrate Soil Screening Thresholds

Wetland Soil COI	Screening Threshold	Unit (dw)	Source
Metals			
Aluminum	600	mg/kg	DEQ (2001)
Antimony	78	mg/kg	Ecological SSL (EPA 2005a)
Arsenic	60	mg/kg	DEQ (2001); Efroymson et al. (1997)
Barium	330	mg/kg	Ecological SSL (EPA 2005b)
Beryllium	40	mg/kg	Ecological SSL (EPA 2005c)
Cadmium	20	mg/kg	DEQ (2001); Efroymson et al. (1997)
Chromium	0.4	mg/kg	DEQ (2001); Efroymson et al. (1997)
Cobalt	1,000	mg/kg	DEQ (2001)
Copper	50	mg/kg	DEQ (2001); Efroymson et al. (1997)
Lead	500	mg/kg	DEQ (2001); Efroymson et al. (1997)
Manganese	100	mg/kg	DEQ (2001)
Mercury	0.1	mg/kg	DEQ (2001); Efroymson et al. (1997)
Nickel	200	mg/kg	DEQ (2001); Efroymson et al. (1997)
Selenium	4.1	mg/kg	Ecological SSL (EPA 2007c)
Silver	50	mg/kg	DEQ (2001)
Zinc	120	mg/kg	Ecological SSL (EPA 2007d)
PAHs[a]			
Total LPAHs[a]	29,000	µg/kg	Ecological SSL (EPA 2007b)
Total HPAHs[b]	18,000	µg/kg	Ecological SSL (EPA 2007b)
Other SVOCs			
1,4-Dichlorobenzene	20,000	µg/kg	DEQ (2001); Efroymson et al. (1997)
Hexachlorobenzene	1,000,000	µg/kg	DEQ (2001)
Pentachlorophenol	4,000	µg/kg	DEQ (2001)
Phenol	30,000	µg/kg	DEQ (2001); Efroymson et al. (1997)

[a] Individual PAH COIs listed in Table 2-18 (acenaphthylene, acenaphthene, anthracene, fluorene, naphthalene, and phenanthrene) were evaluated as part of the total LPAH sum.

[b] Individual PAH COIs listed in Table 2-18 (benzo(a)anthracene, benzo(a)pyrene, total benzofluoranthenes [benzo(b)fluoranthene and benzo(k)fluoranthene], benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, indeno(1,2,3,-c,d)pyrene, fluorene, and pyrene) were evaluated as part of the total HPAH sum.

COI – chemical of interest
DEQ – Oregon Department of Environmental Quality
dw – dry weight
EPA – US Environmental Protection Agency
HPAH – high-molecular-weight polycyclic aromatic hydrocarbon
LPAH – low-molecular-weight polycyclic aromatic hydrocarbon
PAH – polycyclic aromatic hydrocarbon
SSL – soil screening level
SVOC – semivolatile organic compound

Table 2-20. COIs with No Terrestrial Invertebrate Screening Threshold

Wetland Soil COI	
Metals	
Vanadium	
Phthalates	
Bis(2-ethylhexyl) phthalate	Di-n-butyl phthalate
Butyl benzyl phthalate	
PAHs	
2-Methylnaphthlene	Dibenzofuran
Other SVOCs	
4-Methylphenol	Benzyl alcohol
Acetophenone	Biphenyl
Benzaldehyde	Carbazole
Benzoic acid	
PCBs	
Aroclor 1248	Aroclor 1260
Aroclor 1254	Total PCBs
Pesticides	
2,4′-DDD	4,4′-DDT
2,4′-DDE	Total DDTs
2,4′-DDT	delta-BHC
4,4′-DDD	Methoxychlor
4,4′-DDE	
VOCs	
1,2,4-Trimethylbenzene	Methyl ethyl ketone
Acetone	Methyl isobutyl ketone
Benzene	Tetrachloroethene
Carbon disulfide	Toluene
cis-1,2-Dichloroethene	Trichloroethene
p-Cymene	o-Xylene
Dichloromethane	m,p-Xylene
Ethylbenzene	Total xylene
TPH	
TPH-gasoline range	TPH-motor oil range (HCID)
TPH-diesel range (HCID)	TPH-motor oil range
TPH-diesel range	Total petroleum hydrocarbons

BHC – hexachlorocyclohexane
COI – chemical of interest
DDD – dichlorodiphenyldichloroethane
DDE – dichlorodiphenyldichloroethylene
DDT – dichlorodiphenyltrichloroethane
HCID – hydrocarbon identification
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
SVOC – semivolatile organic compound
TPH – total petroleum hydrocarbons
VOC – volatile organic compound

Table 2-21 presents the results of the wetland soil screen for terrestrial invertebrates. Eight COPCs (i.e., aluminum, barium, chromium, copper, manganese, mercury, zinc, and total HPAHs) were identified based on soil data from surface (upper 6 inches) and intermediate (6 to 12 inches[1]) depths because maximum soil concentrations were greater than the lowest soil screening thresholds. These COPCs are evaluated further in the terrestrial invertebrate risk assessment (Section 5.1.2).

Table 2-21. Terrestrial Invertebrate COPC Screen Results for Soil

Wetland Soil COI	Unit (dw)	Maximum Concentration	Screening Threshold	COPC?
Metals				
Aluminum	mg/kg	12,100	600	**yes**
Antimony	mg/kg	8.4	78	no
Arsenic	mg/kg	53.1	60	no
Barium	mg/kg	481	330	**yes**
Beryllium	mg/kg	0.544	40	no
Cadmium	mg/kg	4	20	no
Chromium	mg/kg	149	0.4	**yes**
Cobalt	mg/kg	34.3	1,000	no
Copper	mg/kg	1,240	50	**yes**
Lead	mg/kg	320	500	no
Manganese	mg/kg	1,090	100	**yes**
Mercury	mg/kg	0.4	0.1	**yes**
Nickel	mg/kg	48	200	no
Selenium	mg/kg	1.1	4.1	no
Silver	mg/kg	1.5	50	no
Zinc	mg/kg	748	120	**yes**
PAHs				
Fluorene	µg/kg	417	30,000	no
Total HPAHs	µg/kg	57,000	18,000	**yes**
Total LPAHs	µg/kg	12,200	29,000	no
Other SVOCs				
1,4-Dichlorobenzene	µg/kg	19	20,000	no
Hexachlorobenzene	µg/kg	42	1,000,000	no
Pentachlorophenol	µg/kg	80	4,000	no
Phenol	µg/kg	498	30,000	no

COI – chemical of interest
COPC – chemical of potential concern
dw – dry weight
HPAH – high-molecular-weight polycyclic aromatic hydrocarbon
LPAH – low-molecular-weight polycyclic aromatic hydrocarbon
PAH – polycyclic aromatic hydrocarbon
SVOC – semivolatile organic compound
Bold identifies COPCs.

[1] Berm soil samples included soil collected from the depth interval of 6 to 24 inches.

2.6.3 Fish

This section presents the COPC screen for the fish ROCs (pumpkinseed and brown bullhead), which is summarized in Figure 2-6.

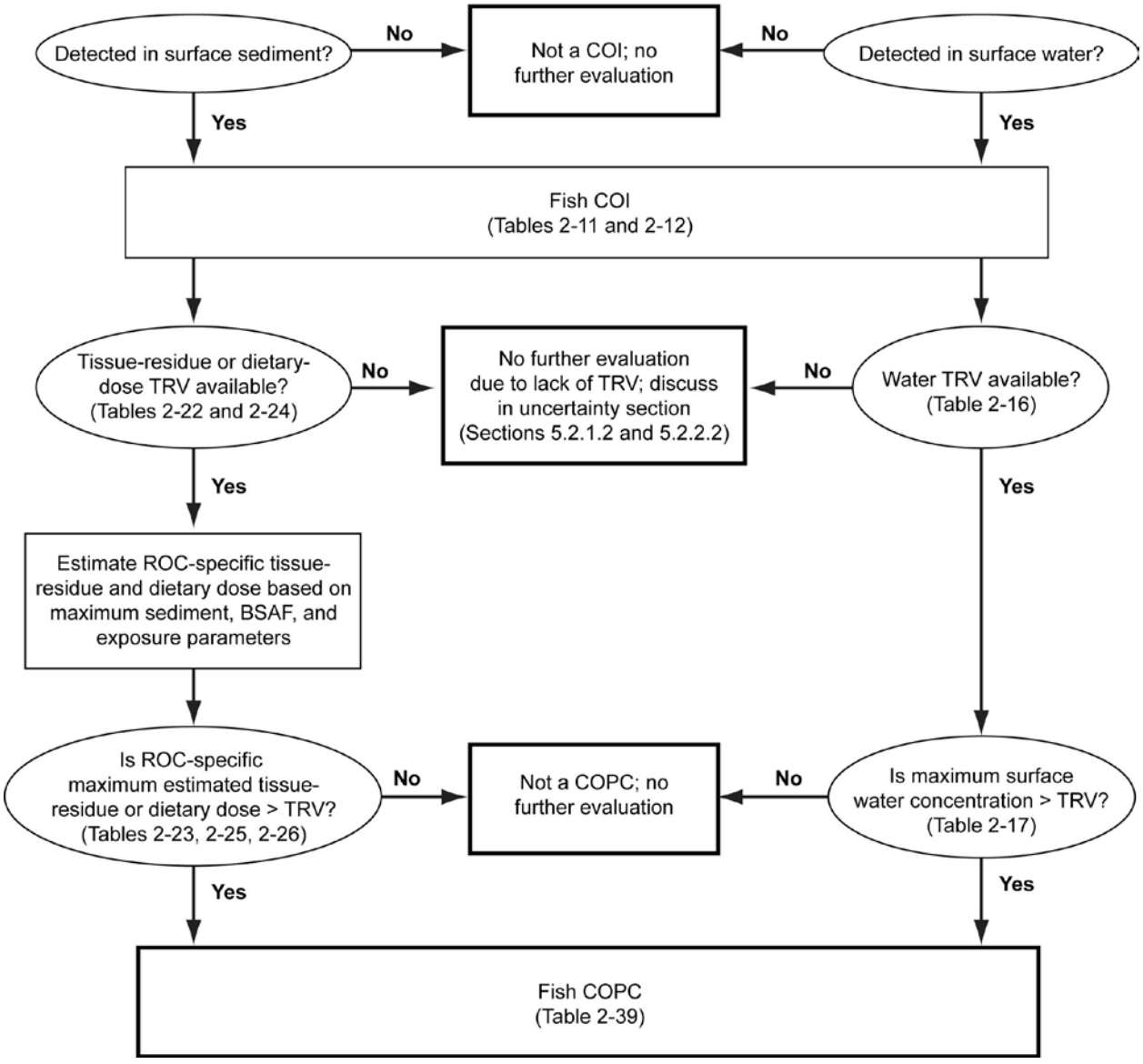

Figure 2-6. COPC Screening Process for Fish ROCs

2.6.3.1 COIs for Fish

The first step in the COPC screen for fish was the identification of COIs. COIs were defined as any analyte detected in surface sediment or surface water. The COIs are presented in Tables 2-11 and 2-12.

COPCs were then developed from the COI lists. For fish, three screens were conducted: 1) a fish tissue-residue screen of all surface sediment COIs, excepted surface sediment COIs evaluated using a dietary approach, 2) a surface water screen of all surface water COIs, and 3) a dietary screen of all surface sediment COIs that are metabolized or regulated by fish (all metals except mercury and all PAHs).These screens are discussed below.

2.6.3.2 Tissue-Residue COPC Screen for Fish

Tissue-residue COPCs for fish ROCs were identified by comparing maximum estimated COI concentrations in fish tissue to tissue-residue no-observed-adverse-effects level (NOAEL)[2] toxicity reference values (TRVs). COIs with maximum concentrations greater than the NOAEL TRVs were identified as COPCs for fish for further evaluation in the ERA in Section 5.2.

A comprehensive literature search was conducted to identify appropriate toxicity studies for the development of fish tissue-residue NOAEL TRVs. The following sources were searched to identify acceptable toxicity studies in the literature for tissue-residue COIs identified for fish:

- BIOSIS
- Environmental Residue Effects Database
- EPA's ECOTOX database
- Jarvinen and Ankley (1999)

Original sources of toxicity data were obtained and reviewed to verify effects data summarized in the databases as well as the suitability of the studies. The databases were searched for studies that evaluated effects on survival, growth, and reproduction.

Acceptable toxicological data that met the following criteria were compiled for fish:

- The chemical concentration in whole body tissue was analyzed as part of the study.
- All selected TRVs were based on laboratory toxicological studies (not field studies). Laboratory studies were used because of the uncertainty surrounding results obtained from field studies (e.g., presence of other chemicals or other confounding factors).
- Studies had to have experimental controls, replicates, and a statistical analysis of the results.
- Selected TRVs based on exposure via diet, sediment, or water were preferred.

[2] NOAEL TRVs are concentrations below which no adverse effects have been observed.

- Other exposure routes including intraperitoneal (IP) or egg injection or oral gavage were only used when no other studies were found.

After the literature search was conducted, all acceptable studies for TRV derivation were compiled. Appendix A provides a table of all fish tissue-residue NOAEL and lowest-observed-adverse-effects level (LOAEL)[3] TRVs reviewed from the literature. The NOAEL TRV was selected as the highest no-effect value below the lowest LOAEL TRV based on the same endpoint. If no NOAEL TRV of the same endpoint was available below the selected LOAEL, an uncertainty factor (UF) was used based on guidance from EPA Region 10 (1997).

Selected tissue-residue NOAEL TRVs are presented in Table 2-22. No tissue TRVs were available for the following tissue COIs: acetone, carbon disulfide, methyl ethyl ketone, toluene, or TPHs; these chemicals are noted in the uncertainty analysis.

Table 2-22. Selected Tissue-Residue NOAEL TRVs for the Fish COPC Screen

Tissue-Residue COI	NOAEL TRV (µg/kg ww)	Endpoint	Source
Metals			
Mercury	230	survival	Webber and Haines (2003)
PCBs			
Total PCBs[a]	104	reproduction	Hugla and Thome (1999)
Pesticides			
Total DDTs[b]	1,800	survival	Allison et al. (1964)

[a] Individual PCB Aroclor COIs listed in Table 2-11 (Aroclor 1254 and Aroclor 1260) were evaluated as part of the total PCB sum.

[b] Individual DDT metabolite COIs listed in Table 2-11 (2,4′-DDD, 4,4′-DDD, and 4,4′-DDE) were evaluated as part of the total DDT sum.

COI – chemical of interest
DDT – dichlorodiphenyltrichloroethane
NOAEL – no-observed-adverse-effect level
PCB – polychlorinated biphenyl
TRV – toxicity reference value
ww – wet weight

For comparison to the NOAEL TRVs, COI concentrations in fish tissue were estimated using fish biota-sediment accumulation factors (BSAFs) and assumptions presented in Appendix B. Total PCB and total DDT BSAFs were based on tissue and sediment data that were lipid and organic-carbon (OC)-normalized, respectively. The average lipid concentrations reported by EPA (2008) for pumpkinseed and brown bullhead (3.1% and 2.6%, respectively) were used to estimate total PCB and total DDT tissue concentrations. An average fish moisture content (72%) reported by EPA (1993) was used to estimate wet weight mercury concentrations in fish tissue from the dry-weight-based mercury BSAF.

Table 2-23 presents the results of the fish tissue COPC screen. Total PCBs was identified as a COPC for both pumpkinseed and brown bullhead. Total PCBs are evaluated further in the fish risk assessment using the tissue-residue approach (Section 5.2).

[3] LOAEL TRVs are the lowest concentrations at which an adverse effect occurred. Acute or subchronic LOAELs were divided by a UF of 10; chronic or critical life-stage LOAELs were divided by a UF of 5; and LC50 (i.e., concentration that is lethal to 50% of an exposed population) (or similar) LOAELs were divided by a UF of 50.

Table 2-23. Results of the COPC Screen for Fish Using the Tissue-Residue Approach

Tissue-Residue COI	BSAF		Maximum Sediment Concentration	Estimated Maximum Tissue Concentration			COPC?
	Value	Unit		Unit (ww)	C_{fish}[a]	NOAEL TRV	
Pumpkinseed							
Mercury	0.38	dw/dw	0.2 mg/kg dw	mg/kg	0.021	0.23	no
Total PCBs	6.45	lipid/OC	1.83 mg/kg OC	µg/kg	370	104	**yes**
Total DDTs	3.0	lipid/OC	3.7 mg/kg OC	µg/kg	340	1,800	no
Brown Bullhead							
Mercury	0.38	dw/dw	0.2 mg/kg dw	mg/kg	0.021	0.23	no
Total PCBs	6.45	lipid/OC	1.83 mg/kg OC	µg/kg	310	104	**yes**
Total DDTs	3.0	lipid/OC	3.7 mg/kg OC	µg/kg	290	1,800	no

[a] C_{fish} was estimated using BSAFs and ROC-specific exposure assumptions. When the sediment concentration was dw, the following equation was used: C_{fish} (ww) = (BSAF x Max_{sed}) x (1 – F_M), where F_M = fraction moisture. When the sediment concentration was OC-normalized, the following equation was used: C_{fish} (ww) = (BSAF x Max_{sed}) x F_L, where F_L = fraction lipid. For pumpkinseed, average percent moisture and percent lipids were 72 and 3.1%, respectively. For brown bullhead, average percent moisture and percent lipids were 72 and 2.6%, respectively. See Appendix B for details on how BSAFs and assumptions were selected.

BSAF – biota-sediment accumulation factor
COI – chemical of interest
COPC – chemical of potential concern
DDT – dichlorodiphenyltrichloroethane
dw – dry weight
NOAEL – no-observed-adverse-effect level
OC – organic carbon
PCB – polychlorinated biphenyl
TRV – toxicity reference value
ww – wet weight
Bold text identifies COPCs.

2.6.3.3 Surface Water COPC Screen for Fish

The second COPC screen conducted for fish involved the use of surface water data. Surface water COPCs for fish were identified through a comparison of maximum surface water concentrations to chronic water screening thresholds. Surface water COPCs for fish were identified using the same water screening thresholds (Table 2-16) as used to identify surface water COPCs for aquatic benthic invertebrates. Consequently, the same COPCs identified in surface water for aquatic benthic invertebrates were identified as COPCs in surface water for fish (Table 2-17).These two COPCs (barium and copper) are evaluated further in the fish risk assessment (Section 5.2).

2.6.3.4 Dietary Dose COPC Screen for Fish

The third COPC screen conducted for fish was conducted using a dietary dose approach for chemicals that are metabolized or regulated by fish (i.e., metals [except mercury] and PAHs). To identify dietary COPCs for fish ROCs, maximum detected concentrations in sediment and maximum estimated chemical concentrations in potential prey items for a given ROC (i.e., pumpkinseed and brown bullhead) were used to estimate a maximum dietary dose (see method described in Section 4.1). COI concentrations in fish prey were estimated using BSAFs and assumptions presented in Appendix B. These concentrations were converted to dietary doses using the approach outlined in Section 3.2.2.

Maximum dietary doses were then compared to dietary-dose NOAEL TRVs; COIs with maximum doses that were greater than the NOAEL TRVs were identified as COPCs.

A comprehensive literature search was conducted on published toxicity studies to date to identify appropriate toxicity studies for the development of dietary-dose TRVs. The following sources were searched to identify acceptable toxicity studies in the literature in order to establish dietary-dose TRVs for fish dietary COIs:

- BIOSIS
- Environmental Residue Effects Database
- EPA's ECOTOX database

Original sources of toxicity data were obtained and reviewed to verify effects data summarized in the databases as well as the suitability of the studies. The databases were searched for studies that evaluated effects on survival, growth, and reproduction.

Acceptable toxicological data that met the following criteria were compiled:

- All studies were based on dietary exposure.
- All selected TRVs were based on laboratory toxicological studies (not field studies). Laboratory studies were used because of the uncertainty surrounding results obtained from field studies (e.g., presence of other chemicals or other confounding factors).
- Studies were excluded if they did not have experimental controls, replicates, and a statistical analysis of the results.

Dietary-dose TRVs (in mg/kg bw/day) were calculated based on the information provided in the acceptable studies. Most toxicological studies presented reported concentrations in mg/kg food; thus, it was necessary to calculate a daily dose (mg/kg bw/day) based on ROC body weight, ingestion rate (IR), and the percent moisture of the food. If this information was not provided in the study, default values were used from the following sources:

- **Body weight:** If no body weight data were provided in the study or data provided were not considered representative, body weights for fish were estimated from other literature sources or toxicity studies.
- **Ingestion rate:** If no ingestion rates were provided in the study, they were estimated from other literature sources for the same species. If no other literature sources were available, an ingestion rate of 2% food (dw)/kg bw/day was assumed as a conservative estimate based on the food ingestion rates commonly reported for laboratory toxicity studies.
- **Percent moisture:** A commercial feed or pelleted diet was assumed to approximate a dw concentration, and 80% moisture was assumed when the diet consisted of organism prey (e.g., invertebrate prey).

Once TRVs were calculated for all studies, NOAEL TRVs were established for COIs using the same criteria described in Section 2.6.3.2. Selected fish dietary TRVs are presented in Table 2-24. Appendix A provides tables of all dietary-dose NOAEL and LOAEL TRVs reviewed from the literature. No dietary-dose TRVs

were available for five fish COIs: barium, cobalt, nickel, 2-methylnaphthalene, and dibenzofuran; these chemicals are noted in the uncertainty analysis. Individual PAH COIs (other than benzo[a]pyrene) were evaluated using TRVs for total PAHs and benzo(a)pyrene.

Table 2-24. Selected Dietary-Dose NOAEL TRVs for the Fish COPC Screen

Dietary COI	Test Species	NOAEL (mg/kg bw/day)	Endpoint	Source
Metals				
Arsenic	rainbow trout	0.40	growth	Oladimeji et al. (1984)
Cadmium	rockfish	0.0020[a]	growth	Kim et al. (2004); Kang et al. (2005)
Chromium	grey mullet	9.42	growth	Walsh et al. (1994)
Copper	rockfish	1.0	growth	Kang et al. (2005)
Lead	rainbow trout	134	growth	Goettl et al. (1976)
Silver	rainbow trout	70	growth	Galvez and Wood (1999)
Vanadium	rainbow trout	0.039[a]	growth	Hilton and Bettger (1988)
Zinc	rainbow trout	19	growth	Takeda and Shimma (1977)
PAHs				
Benzo(a)pyrene	English sole	0.66	growth	Rice et al. (2000)
Total PAHs[b]	Chinook salmon	6.1[c]	growth	Meador et al. (2006)

[a] NOAEL was estimated using a UF of 5 (chronic LOAEL to NOAEL).

[b] Individual PAH COIs listed in Table 2-11 (acenaphthylene, acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, total benzofluoranthenes [benzo(b)fluoranthene and benzo(k)fluoranthene], benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, indeno(1,2,3,-c,d)pyrene, fluoranthene, fluorene, naphthalene, phenanthrene, and pyrene) were evaluated as part of the total PAH sum.

[c] Mixture contained the following 21 PAHs included in the Meador et al. (2006) diet: naphthalene, 2-methylnaphthalene, dimethylnaphthalene, dibenzothiophene, acenaphthene, fluorene, 1,8-dimethyl(9H)fluorene, phenanthrene, 9-ethylphenanthrene, 9-ethyl-10-methylphenanthrene, 1-methyl-7-isopropylphenanthrene, anthracene, fluoranthene, pyrene, methyl pyrene, benzo(a)anthracene, chrysene, benz(a)pyrene, benzo(k)fluoranthene, benzo(g,h,i)perylene, and dibenzanthracene.

bw – body weight
COI – chemical of interest
COPC – chemical of potential concern
dw – dry weight
NOAEL – no-observed-adverse-effect level
PAH – polycyclic aromatic hydrocarbon
UF – uncertainty factor

Tables 2-25 and 2-26 present the results of the dietary COPC screen for fish ROCs. Three COPCs (i.e., cadmium, copper, and vanadium) were identified for both pumpkinseed and brown bullhead. These COPCs are evaluated further in the fish risk assessment (Section 5.2).

Table 2-25. Results of the Pumpkinseed Dietary COPC Screen

Dietary COI	Sediment Concentration		Aquatic Invertebrate BSAF		Prey Tissue Concentration		Estimated Maximum Dose			COPC?
	C_{sed} [a]	Unit	BSAF Value	Unit	$C_{aquat\ invert}$ [b]	Unit	$Dose_{diet}$ [c]	NOAEL TRV	Unit	
Metals										
Arsenic	7	mg/kg dw	0.24	tiss dw/sed dw	0.35	mg/kg ww	0.04	0.4	mg/kg bw/day	no
Cadmium	2	mg/kg dw	3.438	tiss dw/sed dw	1.4	mg/kg ww	0.15	0.002	mg/kg bw/day	**yes**
Chromium	34	mg/kg dw	0.206	tiss dw/sed dw	1.5	mg/kg ww	0.17	9.42	mg/kg bw/day	no
Copper	72	mg/kg dw	2.14	tiss dw/sed dw	32	mg/kg ww	**3.5**	1	mg/kg bw/day	**yes**
Lead	56	mg/kg dw	0.331	tiss dw/sed dw	3.9	mg/kg ww	0.43	134	mg/kg bw/day	no
Vanadium	74	mg/kg dw	1	tiss dw/sed dw	16	mg/kg ww	**1.7**	0.039	mg/kg bw/day	**yes**
Zinc	229	mg/kg dw	3.473	tiss dw/sed dw	170	mg/kg ww	**18**	19	mg/kg bw/day	no
PAHs										
Benzo(a)pyrene	1.3	mg/kg OC	0.383	tiss lipid/sed OC	6.0	µg/kg ww	0.65	660	µg/kg bw/day	no
Total PAHs	19.8	mg/kg OC	0.923	tiss lipid/sed OC	220	µg/kg ww	24	6100	µg/kg bw/day	no

[a] C_{sed} is represented by maximum sediment concentration.

[b] $C_{aquatic\ invert}$ was estimated from C_{sed} (either as a dw concentration or an OC-normalized concentration) and aquatic benthic invertebrate BSAF. When the sediment concentration was dw, the following equation was used: $C_{aquatic\ invert}$ (ww) = (BSAF x Max_{sed}) x (1 – F_M), where F_M = fraction moisture. When the sediment concentration was OC-normalized, the following equation was used: $C_{aquatic\ invert}$ (ww) = (BSAF x Max_{sed}) x F_L, where F_L = fraction lipid. $C_{aquatic\ invert}$ was converted to ww assuming a moisture content of 79% or a lipid content of 1.2%. See Appendix B for details on selected BSAFs and assumptions used to estimate prey tissue concentrations.

[c] $Dose_{diet}$ was calculated using Equation 3-1, exposure parameters presented in Table 3-5, and assumption that diet is comprised of 100% aquatic invertebrates.

BSAF – biota-sediment accumulation factor
bw – body weight
COI – chemical of interest
COPC – chemical of potential concern
dw – dry weight
NOAEL – no-observed-adverse-effect level
OC – organic carbon
PAH – polycyclic aromatic hydrocarbon
TRV – toxicity reference value
ww – wet weight
BOLD identifies COPCs.

Table 2-26. Results of the Brown Bullhead Dietary COPC Screen

Dietary COI	Sediment Concentration		BSAF			Prey Tissue Concentration			Estimated Maximum Dose			COPC?
	C_{sed} [a]	Unit	Fish BSAF	Aquatic Invert BSAF	Unit	C_{fish} [b]	$C_{aquatic\ invert}$ [c]	Unit	$Dose_{diet}$ [d]	NOAEL TRV	Unit	
Metals												
Arsenic	7	mg/kg dw	0.12	0.24	tiss dw/sed dw	0.24	0.35	mg/kg ww	0.032	0.4	mg/kg bw/day	no
Cadmium	2	mg/kg dw	0.785	3.438	tiss dw/sed dw	0.44	1.4	mg/kg ww	**0.089**	0.002	mg/kg bw/day	**yes**
Chromium	34	mg/kg dw	0.043	0.206	tiss dw/sed dw	0.41	1.5	mg/kg ww	0.14	9.42	mg/kg bw/day	no
Copper	72	mg/kg dw	1	2.14	tiss dw/sed dw	20	32	mg/kg ww	**2.1**	1	mg/kg bw/day	**yes**
Lead	56	mg/kg dw	0.18	0.331	tiss dw/sed dw	2.8	3.9	mg/kg ww	0.33	134	mg/kg bw/day	no
Vanadium	74	mg/kg dw	1	1	tiss dw/sed dw	21	16	mg/kg ww	**1.2**	0.039	mg/kg bw/day	**yes**
Zinc	229	mg/kg dw	1.83	3.473	tiss dw/sed dw	120	170	mg/kg ww	11	19	mg/kg bw/day	no
PAHs												
Benzo(a)pyrene	1.3	mg/kg OC	0.0021	0.383	tiss lipid/sed OC	0.1	6	µg/kg ww	0.36	660	µg/kg bw/day	no
Total PAHs	19.8	mg/kg OC	0.0299	0.923	tiss lipid/sed OC	22	220	µg/kg ww	13	6,100	µg/kg bw/day	no

[a] C_{sed} is represented by maximum sediment concentration.

[b] C_{fish} was estimated from C_{sed} (as a dw concentration or an OC-normalized concentration) and a fish BSAF. When the sediment concentration was dw, the following equation was used: C_{fish} (ww) = (BSAF x Max_{sed}) x (1 – F_M), where F_M = fraction moisture. When the sediment concentration was OC-normalized, the following equation was used: C_{fish} (ww) = (BSAF x Max_{sed}) x F_L, where F_L = fraction lipid. C_{fish} was converted to ww assuming a moisture content of 72% or a lipid content of 3.7%. See Appendix B for details on selected BSAFs and assumptions used to estimate prey tissue concentrations.

[c] $C_{aquatic\ invert}$ was estimated from C_{sed} (either as a dw concentration or an OC-normalized concentration) and aquatic benthic invertebrate BSAF. When the sediment concentration was dw, the following equation was used: $C_{aquatic\ invert}$ (ww) = (BSAF x Max_{sed}) x (1 – F_M), where F_M = fraction moisture. When the sediment concentration was OC-normalized, the following equation was used: $C_{aquatic\ invert}$ (ww) = (BSAF x Max_{sed}) x F_L, where F_L = fraction lipid. $C_{aquatic\ invert}$ was converted to ww assuming a moisture content of 79% or a lipid content of 1.2%. See Appendix B for details on selected BSAFs and assumptions used to estimate prey tissue concentrations.

[d] $Dose_{diet}$ was calculated using Equation 3-1, exposure parameters presented in Table 3-5, and assumption that diet is composed of 10% fish and 90% aquatic invertebrates.

BSAF – biota-sediment accumulation factor
bw – body weight
COI – chemical of interest
COPC – chemical of potential concern
dw – dry weight
NOAEL – no-observed-adverse-effect level
OC – organic carbon
PAH – polycyclic aromatic hydrocarbon
TRV – toxicity reference value
ww – wet weight

BOLD identifies COPCs

2.6.4 Aquatic Birds

This section presents the COPC screen for the two aquatic bird ROCs (ruddy duck and great blue heron), which is summarized in Figure 2-7.

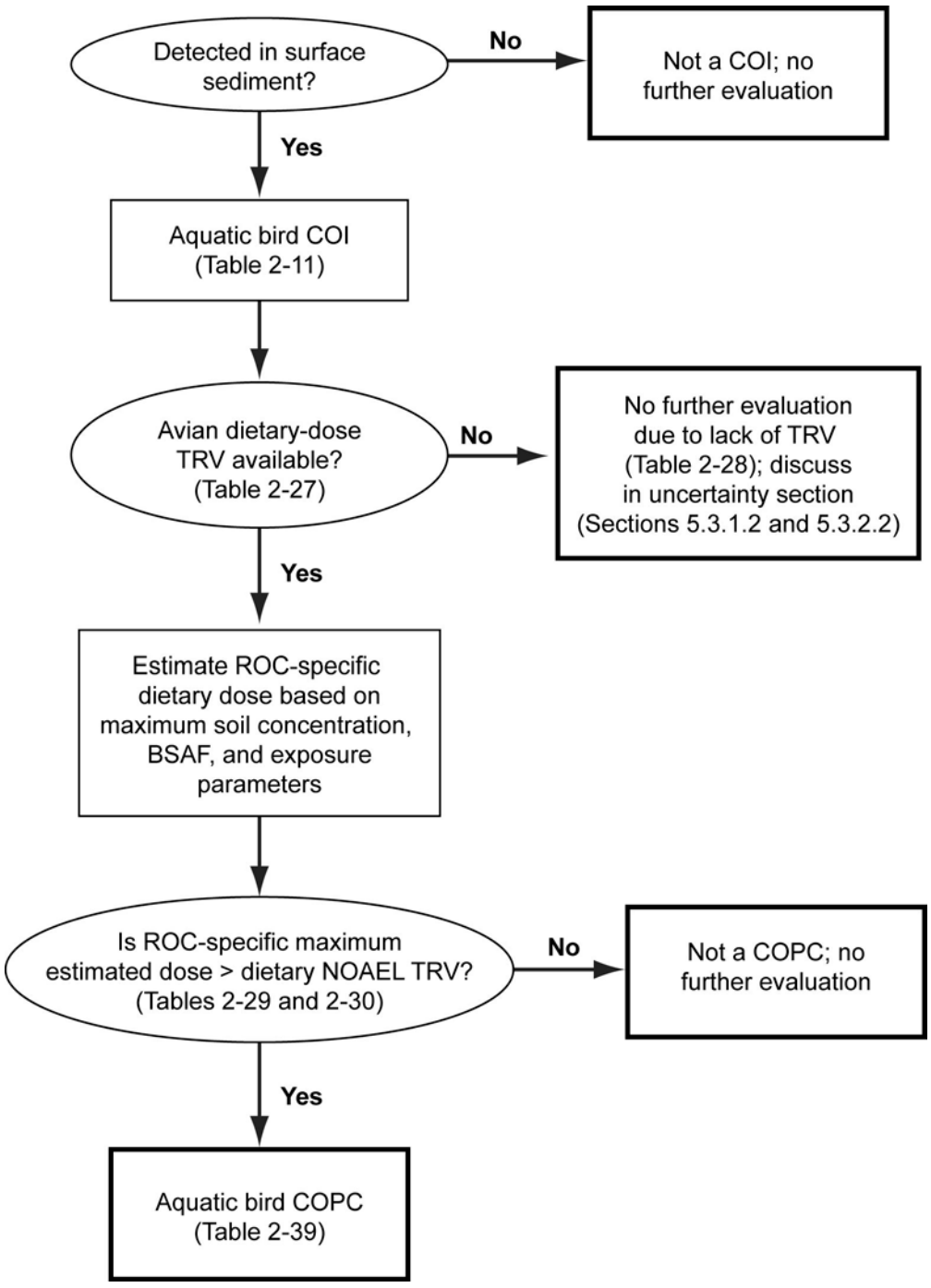

Figure 2-7. COPC Screening Process for Aquatic Bird ROCs

2.6.4.1 COIs for Aquatic Birds

The first step in the COPC screen for aquatic birds was the identification of COIs. COIs were defined as any analyte detected in surface sediment (see Table 2-11).

2.6.4.2 COPC Screen for Aquatic Birds

In the next step to identify COPCs for each of the aquatic bird ROCs, maximum detected concentrations of COIs in sediment and maximum estimated COI concentrations in potential prey items for each ROC were used to estimate a maximum dietary dose (see method described in Section 4.1). COI concentrations in prey were estimated using BSAFs and assumptions presented in Appendix B. These concentrations were converted to dietary doses using the approach outlined in Section 3.2.2. Maximum dietary doses were then compared to dietary-dose NOAEL TRVs; COIs with maximum doses that were greater than the NOAEL TRVs were identified as COPCs.

A comprehensive literature search was conducted on published toxicity studies to date to identify appropriate toxicity studies for the development of dietary-dose TRVs. The following sources were searched to identify acceptable toxicity studies in the literature to establish dietary-dose TRVs for aquatic birds:

- BIOSIS
- EPA's ECOTOX database
- National Library of Medicine's TOXNET database
- US Geological Survey's Contaminant Hazard Review series
- ORNL's database
- EPA's Integrated Risk Information System (IRIS) database
- Agency for Toxic Substances and Disease Registry (ATSDR)

Original sources of toxicity data were obtained and reviewed to verify effects data summarized in the databases as well as the suitability of the studies. The databases were searched for studies that evaluated effects on survival, growth, and reproduction.

Acceptable toxicological data that met the following criteria were compiled:

- Studies conducted based on dietary dose were preferred. As with tissue-residue TRVs, other exposure routes, including IP or egg injection or oral gavage, were used when no other studies were found. Drinking water studies were not used because of differences in the bioavailability of chemicals in water. Non-relevant exposure pathways (e.g., inhalation or absorption) were also not used.
- All selected TRVs were based on laboratory toxicological studies (not field studies). Laboratory studies were used because of the uncertainty surrounding results obtained from field studies (e.g., presence of other chemicals or other confounding factors).
- Studies were excluded if they did not have experimental controls, replicates, and a statistical analysis of the results.

- Egg production studies using chicken or quail, such as Edens and Garlich (1983) and Edens et al. (1976), are highly uncertain because these species have been bred based on high egg-laying rates. These studies were not used.
- Toxicity results based on tests with chemical species considered unlikely to occur at the Study Area (e.g., the fungicide methylmercury dicyandiamide for determining a mercury TRV) were not considered.

Dietary-dose TRVs (in mg/kg bw/day) were calculated based on the information provided in the studies. Most toxicological studies presented reported concentrations in mg/kg food; thus it was necessary to calculate a daily dose (mg/kg bw/day) based on ROC body weight, IR, and the percent moisture of the food. If this information was not provided in the study, default values were used from the following sources:

- **Body weight:** Body weights were selected from EPA's *Wildlife Exposure Factors Handbook* (1993).
- **Ingestion rate:** Allometric equations were used for birds (Nagy 2001), and National Research Council (NRC) data were used for chicks (NRC 1994, 1984).
- **Percent moisture:** Food concentrations were generally reported on a wet-weight basis. However, when concentrations were reported on a dry-weight basis and no percent moisture was provided in the study, a published value from NRC was used based on the diet of the test species (NRC 1994).

Once TRVs had been calculated for all studies, NOAEL TRVs were established for COIs using the same criteria described in Section 2.6.3.2. Selected bird dietary TRVs are presented in Table 2-27. Appendix A provides tables of all dietary-dose NOAEL and LOAEL TRVs reviewed from the literature. The COIs for which no aquatic bird dietary-dose TRV could be developed are presented in Table 2-28; these chemicals will be noted in the uncertainty analysis. Individual PAH COIs (other than benzo[a]pyrene) were evaluated using TRVs for total PAHs and benzo(a)pyrene. Individual DDT metabolite and PCB Aroclor COIs were evaluated using TRVs for total DDTs and total PCBs, respectively.

Table 2-27. Selected Dietary-Dose NOAEL TRVs for the Aquatic Bird COPC Screen

Surface Sediment COI	Test Species	NOAEL (mg/kg bw/day)	Endpoint	Source
Metals				
Arsenic	mallard	10	reproduction	Stanley et al. (1994)
Cadmium	mallard	1.5	growth	Cain et al. (1983)
Chromium	black duck	1.0	reproduction	Haseltine et al. (unpublished), as cited in Sample et al. (1996)
Cobalt	chicken	2.31[a]	growth	Diaz et al. (1994)

Table 2-27. Selected Dietary-Dose NOAEL TRVs for the Aquatic Bird COPC Screen

Surface Sediment COI	Test Species	NOAEL (mg/kg bw/day)	Endpoint	Source
Copper	chicken	21	growth	Poupoulis and Jensen (1976)
Lead	American kestrel	5.82	reproduction	Pattee (1984)
Mercury	great egret	0.018[b]	growth	Spalding et al. (2000)
Nickel	mallard	77	growth	Cain and Pafford (1981)
Vanadium	chicken	1.2	growth	Ousterhout and Berg (1981)
Zinc	chicken	82	growth	Roberson and Schaible (1960)
PAHs				
Benzo(a)pyrene	pigeon	0.28[b]	reproduction	Hough et al. (1993)
Total PAHs[c]	mallard	8.0	growth	Patton and Dieter (1980)
PCBs				
Total PCBs[d]	screech owl	0.49	reproduction	McLane and Hughes (1980)
Pesticides				
Total DDTs[e]	barn owl	0.064[f]	reproduction	Mendenhall et al. (1983)
VOCs				
Acetone	four species	6,647	survival	Hill et al. (1975)

[a] NOAEL was estimated from an acute or subchronic LOAEL using a UF of 10.

[b] NOAEL was estimated from a chronic LOAEL using a UF of 5.

[c] Individual PAH COIs listed in Table 2-11 (acenaphthylene, acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, total benzofluoranthenes [benzo(b)fluoranthene and benzo(k)fluoranthene], benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, indeno(1,2,3,-c,d)pyrene, fluoranthene, fluorene, naphthalene, phenanthrene, and pyrene) were evaluated as part of the total PAH sum.

[d] Individual PCB Aroclor COIs listed in Table 2-11 (Aroclor 1254 and Aroclor 1260) were evaluated as part of the total PCB sum.

[e] Individual DDT metabolite COIs listed in Table 2-11 (2,4′-DDD, 4,4′-DDD, and 4,4′-DDE) were evaluated as part of the total DDT sum.

bw – body weight
COI – chemical of interest
COPC – chemical of potential concern
DDT – dichlorodiphenyltrichloroethane
NOAEL – no-observed-adverse-effect level
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
TRV – toxicity reference value
UF – uncertainty factor
VOC – volatile organic compound

Table 2-28. COIs without Aquatic Bird NOAEL TRVs

Surface Sediment COI	
Metals	
Barium	
PAHs	
2-Methylnapthalene	Dibenzofuran
VOCs	
Carbon disulfide	Toluene
Methyl ethyl ketone	
TPH	
TPH-gasoline range	TPH-motor oil range
TPH-diesel range	Total petroleum hydrocarbons

COI – chemical of interest
NOAEL – no-observed-adverse-effect level
TPH – total petroleum hydrocarbons
TRV – toxicity reference value
VOC – volatile organic compound

Tables 2-29 and 2-30 present the results of the dietary COPC screen for both aquatic bird ROCs. Three COPCs (i.e., mercury, vanadium, and total DDTs) were identified for ruddy duck and two COPCs (i.e., vanadium and total DDTs) were identified for great blue heron. These COPCs are evaluated further in the wildlife risk assessment for each of these ROCs (Section 5.3)

Table 2-29. Results of the Ruddy Duck Dietary COPC Screen

Surface Sediment COI	Sediment Concentration		BSAF		Prey Tissue Concentration		Estimated Maximum Dose			COPC?
	C_{sed} [a]	Unit	Aquatic Invert BSAF	Unit	$C_{aquat\ invert}$ [b]	Unit	$Dose_{diet}$ [c]	NOAEL TRV	Unit	
Metals										
Arsenic	7	mg/kg dw	0.24	tiss dw/sed dw	0.35	mg/kg ww	0.17	10	mg/kg bw/day	no
Cadmium	2	mg/kg dw	3.438	tiss dw/sed dw	1.4	mg/kg ww	0.51	1.5	mg/kg bw/day	no
Chromium	34	mg/kg dw	0.206	tiss dw/sed dw	1.5	mg/kg ww	0.76	1	mg/kg bw/day	no
Cobalt	15	mg/kg dw	1	tiss dw/sed dw	3.2	mg/kg ww	1.2	2.31	mg/kg bw/day	no
Copper	72	mg/kg dw	2.14	tiss dw/sed dw	32	mg/kg ww	12	21	mg/kg bw/day	no
Lead	56	mg/kg dw	0.331	tiss dw/sed dw	3.9	mg/kg ww	1.7	5.82	mg/kg bw/day	no
Mercury	0.2	mg/kg dw	1.204	tiss dw/sed dw	0.051	mg/kg ww	**0.019**	0.018	mg/kg bw/day	**yes**
Nickel	31	mg/kg dw	1.313	tiss dw/sed dw	8.5	mg/kg ww	3.1	77	mg/kg bw/day	no
Vanadium	74	mg/kg dw	1	tiss dw/sed dw	16	mg/kg ww	**6.0**	1.2	mg/kg bw/day	**yes**
Zinc	229	mg/kg dw	3.473	tiss dw/sed dw	170	mg/kg ww	60	82	mg/kg bw/day	no
PAHs										
Benzo(a)pyrene	1.3	mg/kg OC	0.383	tiss lipid/sed OC	6.0	µg/kg ww	2.1	280	µg/kg bw/day	no
Total PAHs	19.8	mg/kg OC	0.923	tiss lipid/sed OC	220	µg/kg ww	76	8,000	µg/kg bw/day	no
PCBs										
Total PCBs	1.83	mg/kg OC	2.57	tiss lipid/sed OC	56	µg/kg ww	19	490	µg/kg bw/day	no
Pesticides										
Total DDTs	3.7	mg/kg OC	4.52	tiss lipid/sed OC	200	µg/kg ww	**69**	64	µg/kg bw/day	**yes**
VOCs										
Acetone	14	mg/kg OC	1	tiss lipid/sed OC	170	µg/kg ww	59	6,647,000	µg/kg bw/day	no

[a] C_{sed} is represented by maximum sediment concentration.

[b] $C_{aquatic\ invert}$ was estimated from C_{sed} (either as a dw concentration or an OC-normalized concentration) and aquatic benthic invertebrate BSAF. When the sediment concentration was dw, the following equation was used:, $C_{aquatic\ invert}$ (ww) = (BSAF x Max_{sed}) x (1 – F_M), where F_M = fraction moisture. When the sediment concentration was OC-normalized, the following equation was used: $C_{aquatic\ invert}$ (ww) = (BSAF x Max_{sed}) x F_L, where F_L = fraction lipid. $C_{aquatic\ invert}$ was converted to ww assuming a moisture content of 79% or a lipid content of 1.2%. See Appendix B for details on selected BSAFs and assumptions used to estimate prey tissue concentrations.

[c] $Dose_{diet}$ was calculated using Equation 3-1, exposure parameters presented in Table 3-9, and assumption that diet is composed of 100% aquatic invertebrates.

BSAF – biota-sediment accumulation factor
bw – body weight
dw – dry weight
NOAEL – no-observed-adverse-effect level
PCB – polychlorinated biphenyl
TRV – toxicity reference value

COI – chemical of interest
COPC – chemical of potential concern
DDT – dichlorodiphenyltrichloroethane
BOLD identifies COPCs.

OC – organic carbon
PAH – polycyclic aromatic hydrocarbon

VOC – volatile organic compound
ww – wet weight

Table 2-30. Results of the Great Blue Heron Dietary COPC Screen

Surface Sediment COI	Sediment Concentration		BSAF			Prey Tissue Concentration			Estimated Maximum Dose			COPC?
	C_{sed} [a]	Unit	Fish BSAF	Aquatic Invert BSAF	Unit	C_{fish} [b]	$C_{aquat\ invert}$ [c]	Unit	$Dose_{diet}$ [d]	NOAEL TRV	Unit	
Metals												
Arsenic	7	mg/kg dw	0.12	0.24	tiss dw/sed dw	0.24	0.35	mg/kg ww	0.05	10	mg/kg bw/day	no
Cadmium	2	mg/kg dw	0.785	3.438	tiss dw/sed dw	0.44	1.4	mg/kg ww	0.09	1.5	mg/kg bw/day	no
Chromium	34	mg/kg dw	0.043	0.206	tiss dw/sed dw	0.41	1.5	mg/kg ww	0.12	1	mg/kg bw/day	no
Cobalt	15	mg/kg dw	1	1	tiss dw/sed dw	4.2	3.2	mg/kg ww	0.76	2.31	mg/kg bw/day	no
Copper	72	mg/kg dw	1	2.14	tiss dw/sed dw	20	32	mg/kg ww	3.8	21	mg/kg bw/day	no
Lead	56	mg/kg dw	0.18	0.331	tiss dw/sed dw	2.8	3.9	mg/kg ww	0.57	5.82	mg/kg bw/day	no
Mercury	0.2	mg/kg dw	0.38	1.204	tiss dw/sed dw	0.021	0.051	mg/kg ww	0.0043	0.018	mg/kg bw/day	no
Nickel	31	mg/kg dw	1	1.313	tiss dw/sed dw	8.7	8.5	mg/kg ww	1.6	77	mg/kg bw/day	no
Vanadium	74	mg/kg dw	1	1	tiss dw/sed dw	21	16	mg/kg ww	**3.8**	1.2	mg/kg bw/day	**yes**
Zinc	229	mg/kg dw	1.83	3.473	tiss dw/sed dw	118	167	mg/kg ww	22	82	mg/kg bw/day	no
PAHs												
Benzo(a)pyrene	1.3	mg/kg OC	0.0021	0.383	tiss lipid/ sed OC	0.10	6.0	µg/kg ww	0.072	280	µg/kg bw/day	no
Total PAHs	19.8	mg/kg OC	0.0299	0.923	tiss lipid/ sed OC	22	220	µg/kg ww	5.8	8,000	µg/kg bw/day	no
PCBs												
Total PCBs	1.83	mg/kg OC	6.45	2.57	tiss lipid/ sed OC	440	56	µg/kg ww	76	490	µg/kg bw/day	no
Pesticides												
Total DDTs	3.7	mg/kg OC	3.0	4.52	tiss lipid/ sed OC	410	200	µg/kg ww	72	64	µg/kg bw/day	**yes**
VOCs												
Acetone	14	mg/kg OC	1	1	tiss lipid/ sed OC	520	170	µg/kg ww	90	6,647,000	µg/kg bw/day	no

[a] C_{sed} is represented by maximum sediment concentration.

[b] C_{fish} was estimated from C_{sed} (either as a dw concentration or an OC-normalized concentration) and fish BSAF. When the sediment concentration was dw, the following equation was used: C_{fish} (ww) = (BSAF x Max_{sed}) x (1 – F_M), where F_M = fraction moisture. When the sediment concentration was OC-normalized, the following equation was used: Max_{sed} (OC), C_{fish} (ww) = (BSAF x Max_{sed}) x F_L, where F_L = fraction lipid. C_{fish} was converted to ww assuming a

moisture content of 72% or a lipid content of 3.7%. See Appendix B for details on selected BSAFs and assumptions used to estimate prey tissue concentrations.

[c] $C_{aquatic\ invert}$ was estimated from C_{sed} (either as a dw concentration or an OC-normalized concentration) and aquatic benthic invertebrate BSAF. When the sediment concentration was dw, the following equation was used: $C_{aquatic\ invert}$ (ww) = (BSAF x Max_{sed}) x (1 – F_M), where F_M = fraction moisture When the sediment concentration was OC-normalized, the following equation was used: $C_{aquatic\ invert}$ (ww) = (BSAF x Max_{sed}) x F_L, where F_L = fraction lipid. $C_{aquatic\ invert}$ was converted to ww assuming a moisture content of 79% or a lipid content of 1.2%. See Appendix B for details on selected BSAFs and assumptions used to estimate prey tissue concentrations.

[d] $Dose_{diet}$ was calculated using Equation 3-1, exposure parameters presented in Table 3-9, and assumption that diet is composed of 95% fish and 5% aquatic invertebrates.

BSAF – biota-sediment accumulation factor
bw – body weight
COI – chemical of interest
COPC – chemical of potential concern
DDT – dichlorodiphenyltrichloroethane
dw – dry weight
NOAEL –no-observed-adverse-effect level
OC – organic carbon
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
TRV – toxicity reference value
VOC – volatile organic compound
ww – wet weight
BOLD identifies COPCs.

2.6.5 Terrestrial Birds

This section presents the COPC screen, which is summarized in Figure 2-8, for the terrestrial bird ROC (the red-tailed hawk).

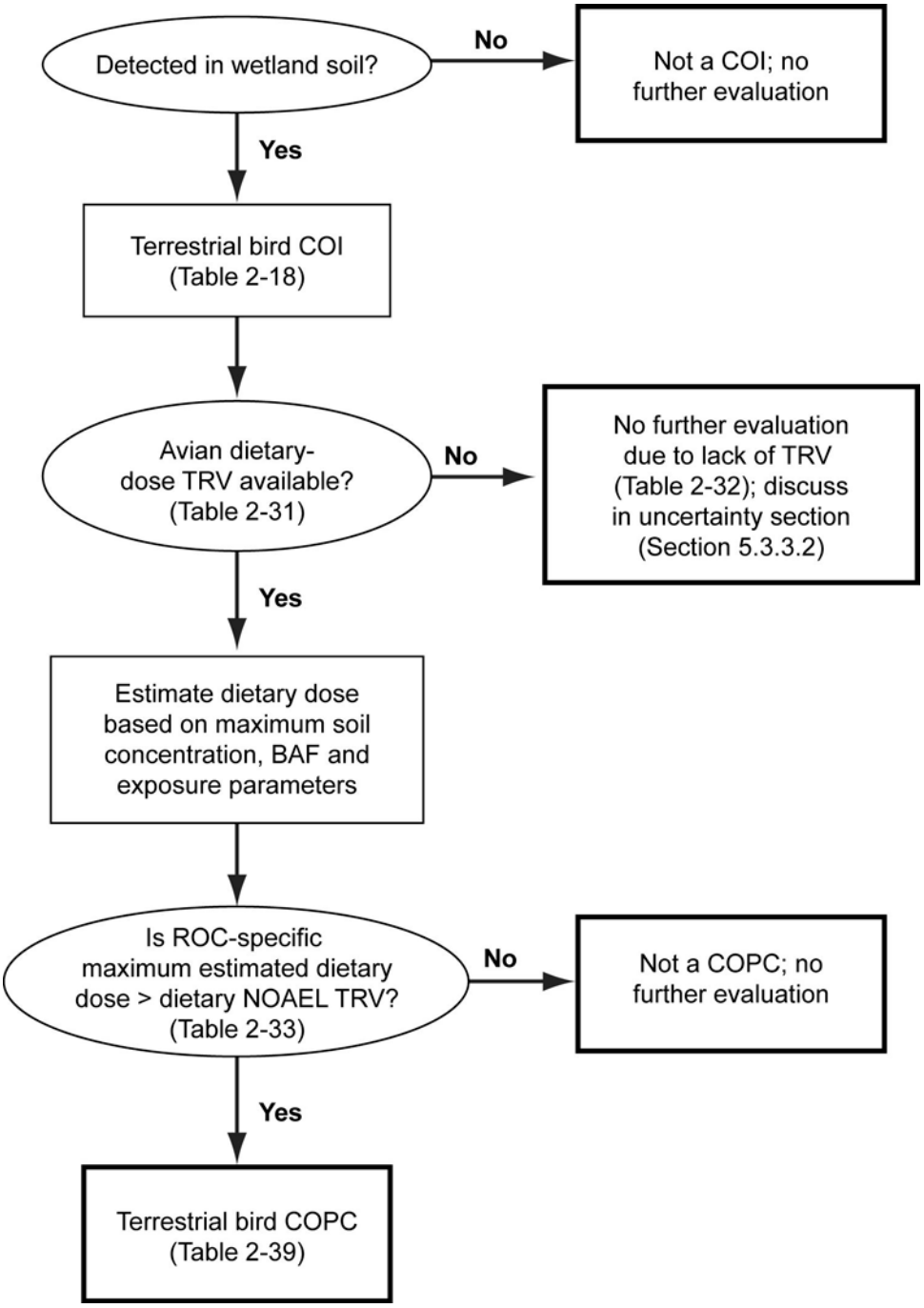

Figure 2-8. COPC Screening Process for Terrestrial Bird ROCs

2.6.5.1 COIs for Terrestrial Birds

The first step in the COPC screen for the terrestrial bird ROC was the identification of COIs. COIs were defined as any analyte detected in wetland soil (see Table 2-18).

2.6.5.2 COPC Screen for Terrestrial Birds

In the next step to identify COPCs for red-tailed hawk, maximum detected COI concentrations in soil and maximum estimated COI concentrations in potential prey items were used to estimate a maximum dietary doses for each COI (see method described in Section 4.1). COI concentrations in prey were estimated using biota accumulation factors (BAFs) and assumptions presented in Appendix B. These concentrations were converted to dietary doses using the approach outlined in Section 3.2.2. Maximum dietary doses were then compared to dietary-dose NOAEL TRVs; COIs with maximum doses that were greater than the NOAEL TRVs were identified as COPCs for red-tailed hawk.

NOAEL TRVs, presented in Table 2-31, were identified using the process presented in Section 2.6.3.2. The COIs without available terrestrial bird NOAEL TRVs are presented in Table 2-32; these COIs will be noted in the uncertainty analysis. Individual PAH COIs (other than benzo[a]pyrene) were evaluated using TRVs for total PAHs and benzo(a)pyrene. Individual DDT metabolite and PCB Aroclor COIs were evaluated using TRVs for total DDTs and total PCBs, respectively.

Table 2-31. Selected Dietary-Dose NOAEL TRVs for the Terrestrial Bird COPC Screen

Wetland Soil COI	Test Species	NOAEL (mg/kg bw/day)	Endpoint	Source
Metals				
Aluminum	Japanese quail	157	reproduction, growth	Carriere et al. (1986)
Arsenic	mallard	10	reproduction	Stanley et al. (1994)
Cadmium	mallard	1.5	growth	Cain et al. (1983)
Chromium	black duck	1.0	reproduction	Haseltine et al. (unpublished), as cited in Sample et al. (1996)
Cobalt	chicken	2.31[a]	growth	Diaz et al. (1994)
Copper	chicken	21	growth	Poupoulis and Jensen (1976)
Lead	American kestrel	5.82	reproduction	Pattee (1984)
Mercury	great egret	0.018[b]	growth	Spalding et al. (2000)
Nickel	mallard	77	growth	Cain and Pafford (1981)
Selenium	mallard	0.50	reproduction	Heinz et al. (1987)
Vanadium	chicken	1.2	growth	Ousterhout and Berg (1981)

Table 2-31. Selected Dietary-Dose NOAEL TRVs for the Terrestrial Bird COPC Screen

Wetland Soil COI	Test Species	NOAEL (mg/kg bw/day)	Endpoint	Source
Zinc	chicken	82	growth	Roberson and Schaible (1960)
PAHs				
Benzo(a)pyrene	pigeon	0.28[b]	reproduction	Hough et al. (1993)
Total PAHs[c]	mallard	8.0	growth	Patton and Dieter (1980)
Phthalates				
BEHP	chicken	65.8[d]	reproduction	Ishida et al. (1982)
Butyl benzyl phthalate	chicken	65.8[d]	reproduction	BEHP TRVs
Di-n-butyl phthalate	chicken	65.8[d]	reproduction	BEHP TRVs
Other SVOCs				
Hexachloro-benzene	Japanese quail	1.1	reproduction	Vos et al. (1971)
Pentachlorophenol	chicken	22	growth	Prescott et al. (1982)
PCBs				
Total PCBs[e]	screech owl	0.49	reproduction	McLane and Hughes (1980)
Pesticides				
Total DDTs[f]	barn owl	0.064[g]	reproduction	Mendenhall et al. (1983)
delta-BHC[h]	mallard	1.6[h]	reproduction	Chakravarty and Lahiri (1986); Chakravarty et al. (1986)[i]
Methoxychlor	zebra finch	34.6	reproduction	Gee et al. (2004)[i]
			survival	Millam et al. (2002)[i]
VOCs				
Acetone	four species	6,647	survival	Hill et al. (1975)

[a] NOAEL was estimated from an acute or subchronic LOAEL using a UF of 10.

[b] NOAEL was estimated from a chronic LOAEL using a UF of 5.

[c] Individual PAH COIs listed in Table 2-18 (acenaphthylene, acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, total benzofluoranthenes [benzo(b)fluoranthene and benzo(k)fluoranthene], benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, indeno(1,2,3,-c,d)pyrene, fluoranthene, fluorene, naphthalene, phenanthrene, and pyrene) were evaluated as part of the total PAH sum.

[d] There was a NOAEL of 1.45 mg/kg bw/day from a study that reported no effect on eggshell thinning, but this is an unbounded NOAEL at a substantially lower concentration than that in the study with observed effects. Therefore, the NOAEL was estimated from the reproductive LOAEL using a UF of 5.

[e] Individual PCB Aroclor COIs listed in Table 2-18 (Aroclor 1248, Aroclor 1254, and Aroclor 1260) were evaluated as part of the total PCB sum.

[f] Individual DDT metabolite COIs listed in Table 2-18 (2,4′-DDD, 2,4′-DDE, 2,4′-DDT, 4,4′-DDD, 4,4′-DDE, and 4,4′-DDT) were evaluated as part of the total DDT sum.

[g] There was a NOAEL of 0.19 mg/kg bw/day from a study that reported no effect on eggshell thinning from exposure of barn owls to DDT (Mendenhall et al. 1983). However, as discussed in Section 6.3.1.2, there is evidence indicating that p,p'-DDE rather than DDT was the likely

cause of eggshell thinning (Lundholm 1997). Therefore, the NOAEL was estimated from the DDE LOAEL for eggshell thinning using a factor of 5.

[h] TRVs for delta-BHC were based on TRVs reported for gamma-BHC (lindane).

[i] Both studies had the same LOAEL and NOAEL.

BEHP – bis(2-ethylhexyl) phthalate
BHC – hexachlorocyclohexane
bw – body weight
COI – chemical of interest
COPC – chemical of potential concern
DDT – dichlorodiphenyltrichloroethane
NOAEL – no-observed-adverse-effect level
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
SVOC – semivolatile organic compound
TRV – toxicity reference value
UF – uncertainty factor
VOC – volatile organic compound

Table 2-32. COIs without Terrestrial Bird NOAEL TRVs

Surface Sediment COI	
Metals	
Antimony	Manganese
Barium	Silver
Beryllium	
PAHs	
2-Methylnaphthalene	Dibenzofuran
Other SVOCs	
1,4-Dichlorobenzene	Benzyl alcohol
4-Methylphenol	Biphenyl
Acetophenone	Carbazole
Benzaldehyde	Phenol
Benzoic acid	
VOCs	
1,2,4-Trimethylbenzene	Methyl isobutyl ketone
Benzene	Tetrachloroethene
Carbon disulfide	Toluene
cis-1,2-Dichloroethene	Trichloroethene
p-Cymene	o-Xylene
Dichloromethane	m,p-Xylene
Ethylbenzene	Total xylenes
Methyl ethyl ketone	
TPH	
TPH-gasoline range	TPH-motor oil range (HCID)
TPH-diesel range (HCID)	TPH-motor oil range
TPH-diesel range	Total petroleum hydrocarbons

COI – chemical of interest
NOAEL – no-observed-adverse-effect level
HCID – hydrocarbon identification
PAH – polycyclic aromatic hydrocarbon
SVOC – semivolatile organic compound
TPH – total petroleum hydrocarbons
TRV – toxicity reference value
VOC – volatile organic compound

Table 2-33 presents the results of the dietary COPC screen for red-tailed hawk. Two COPCs (i.e., aluminum and total DDTs) were identified. These COPCs are evaluated further in the wildlife risk assessment for this ROC (Section 5.3).

Table 2-33. Results of the Red-Tailed Hawk Dietary COPC Screen

Wetland Soil COI	Soil Concentration		BAF		Prey Tissue Concentration		Estimated Maximum Dose			COPC?
	C_{soil} [a]	Unit (dw)	Mammal BAF	Unit	C_{mammal} [b]	Unit (ww)	$Dose_{diet}$ [c]	NOAEL TRV	Unit	
Metals										
Aluminum	12,100	mg/kg	1	tiss dw/sed dw	3900	mg/kg	**390**	157	mg/kg bw/day	**yes**
Arsenic	53.1	mg/kg	0.0063	tiss dw/sed dw	0.11	mg/kg	0.028	10	mg/kg bw/day	no
Cadmium	4	mg/kg	1.9902	tiss dw/sed dw	2.5	mg/kg	0.25	1.5	mg/kg bw/day	no
Chromium	149	mg/kg	0.1382	tiss dw/sed dw	6.6	mg/kg	0.7	1	mg/kg bw/day	no
Cobalt	34.3	mg/kg	0.0371	tiss dw/sed dw	0.41	mg/kg	0.051	2.31	mg/kg bw/day	no
Copper	1,240	mg/kg	0.42	tiss dw/sed dw	170	mg/kg	17	21	mg/kg bw/day	no
Lead	320	mg/kg	0.1615	tiss dw/sed dw	17	mg/kg	1.8	5.82	mg/kg bw/day	no
Mercury	0.4	mg/kg	0.1244	tiss dw/sed dw	0.016	mg/kg	0.0017	0.018	mg/kg bw/day	no
Nickel	48	mg/kg	0.2799	tiss dw/sed dw	4.3	mg/kg	0.44	77	mg/kg bw/day	no
Selenium	1.1	mg/kg	0.3464	tiss dw/sed dw	0.12	mg/kg	0.012	0.5	mg/kg bw/day	no
Vanadium	148	mg/kg	0.0123	tiss dw/sed dw	0.58	mg/kg	0.10	1.2	mg/kg bw/day	no
Zinc	748	mg/kg	1.3352	tiss dw/sed dw	320	mg/kg	32	82	mg/kg bw/day	no
PAHs										
Benzo(a)pyrene	4,000	µg/kg	0.001	tiss dw/sed dw	1.3	µg/kg	1.4	280	µg/kg bw/day	no
Total PAHs	69,000	µg/kg	0.001	tiss dw/sed dw	22	µg/kg	24	8,000	µg/kg bw/day	no
Phthalates										
BEHP	9,100	µg/kg	1	tiss dw/sed dw	2,900	µg/kg	290	65,800	µg/kg bw/day	no
Butyl benzyl phthalate	3,140	µg/kg	1	tiss dw/sed dw	1,000	µg/kg	100	65,800	µg/kg bw/day	no
Di-n-butyl phthalate	2,400	µg/kg	1	tiss dw/sed dw	770	µg/kg	77	65,800	µg/kg bw/day	no
Other SVOCs										
Hexachlorobenzene	42	µg/kg	1	tiss dw/sed dw	13	µg/kg	1.3	1,100	µg/kg bw/day	no
Pentachlorophenol	80	µg/kg	1	tiss dw/sed dw	26	µg/kg	2.6	22,000	µg/kg bw/day	no
PCBs										
Total PCBs	4,200	µg/kg	0.45	tiss-ww/sed dw	1,900	µg/kg	190	490	µg/kg bw/day	no
Pesticides										
Total DDTs	46,000	µg/kg	C_{mammal} = ([C_{plant} x 0.75]+[C_{invert} x 0.25]) x 4.83 [d]	tiss dw/sed dw	200,000 [d]	µg/kg	**20,000**	64	µg/kg bw/day	**yes**
delta-BHC	3	µg/kg	0.157	tiss dw/sed dw	0.15	µg/kg	0.016	1,600	µg/kg bw/day	no

Table 2-33. Results of the Red-Tailed Hawk Dietary COPC Screen

Wetland Soil COI	Soil Concentration		BAF		Prey Tissue Concentration		Estimated Maximum Dose			COPC?
	C_{soil} [a]	Unit (dw)	Mammal BAF	Unit	C_{mammal} [b]	Unit (ww)	$Dose_{diet}$ [c]	NOAEL TRV	Unit	
Methoxychlor	4.6	µg/kg	1	tiss dw/sed dw	1.5	µg/kg	0.15	34,600	µg/kg bw/day	no
VOCs										
Acetone	2,300	µg/kg	1	tiss dw/sed dw	740	µg/kg	74	6,647,000	µg/kg bw/day	no

[a] C_{soil} is represented by maximum soil concentration.

[b] C_{mammal} was estimated from C_{soil} and a mammal BAF and converted to ww assuming percent moisture of 68%. C_{mammal} (ww) = [BAF(dw/dw) x Max_{soil}] x (1 – F_M), where F_M = fraction moisture. See Appendix B for details on selected BAFs and assumptions used to estimate prey tissue concentrations.

[c] $Dose_{diet}$ was calculated using Equation 3-5, exposure parameters presented in Table 3-9, and assumption that diet is composed of 100% terrestrial small mammals.

[d] C_{mammal} was calculated using BAF regression, where C_{plant} = 261 µg/kg dw and C_{invert} = 515,200 µg/kg dw.

BAF – bioaccumulation factor
BEHP – bis(2-ethylhexyl) phthalate
BHC – hexachlorocyclohexane
bw – body weight
COI – chemical of interest
COPC – chemical of potential concern
DDT – dichlorodiphenyltrichloroethane
dw – dry weight
NOAEL – no-observed-adverse-effect level
OC – organic carbon
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
SVOC – semivolatile organic compound
TRV – toxicity reference value
VOC – volatile organic compound
ww – wet weight

BOLD identifies COPCs.

2.6.6 Terrestrial Mammals

This section presents the COPC screen, which is summarized in Figure 2-9 for the terrestrial mammal ROCs (Eastern cottontail and shrew).

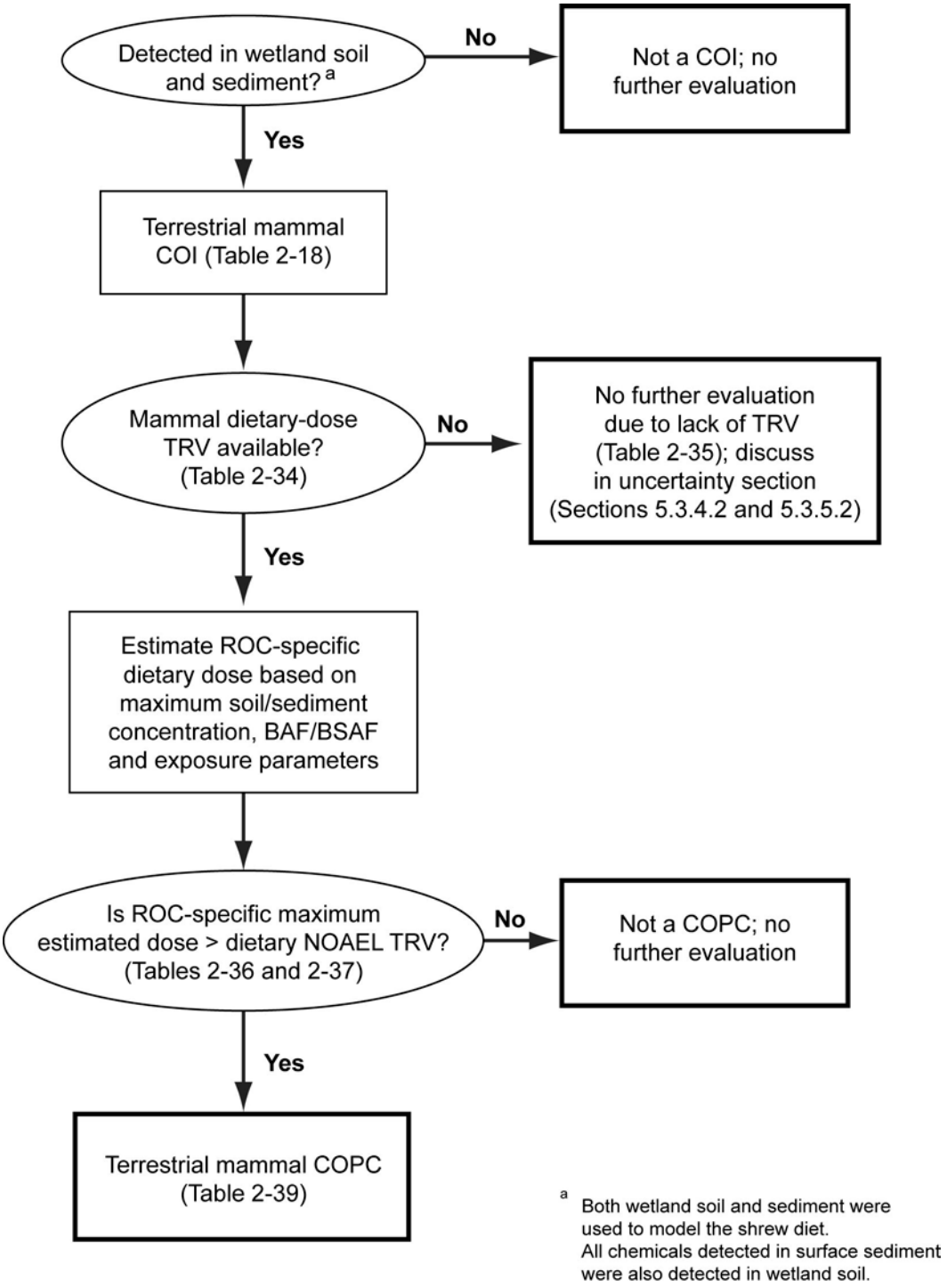

Figure 2-9. COPC Screening Process for Terrestrial Mammal ROCs

2.6.6.1 COIs for Terrestrial Mammals

The first step in the COPC screen for terrestrial mammals was the identification of COIs. COIs were defined as any analyte detected in wetland soil[4] (see Table 2-18).

2.6.6.2 COPC Screen for Terrestrial Mammals

In the next step to identify COPCs for terrestrial mammal ROCs, maximum detected COI concentrations in sediment and soil[5] and maximum estimated COI concentrations in potential prey items were used to estimate a ROC-specific maximum dietary dose (see method described in Section 4.1). COI concentrations in prey were estimated using BSAFs and BAFs and assumptions presented in Appendix B. These concentrations were converted to dietary doses using the approach outlined in Section 3.2.2. Maximum dietary doses were then compared to dietary-dose NOAEL TRVs for mammals; COIs with maximum doses that were greater than the TRVs were identified as COPCs for the ROC.

NOAEL TRVs were identified using the process presented in Section 2.6.3.2, with one exception: allometric equations based on laboratory data were used to estimate the ingestion rate for mammals (EPA 1988).

Selected NOAEL TRVs for mammals are presented in Table 2-34. Individual PAH COIs (other than benzo[a]pyrene, naphthalene, and 2-methylnaphthalene) were evaluated using TRVs for benzo(a)pyrene and total PAHs. Individual DDT metabolite and PCB Aroclor COIs were evaluated using TRVs for total DDTs and total PCBs, respectively. The COIs for which no mammal dietary-dose TRV could be developed are presented in Table 2-35; these COIs are noted in the uncertainty analysis.

Table 2-34. Selected Dietary-Dose NOAEL TRVs for the Terrestrial Mammal COPC Screen

Wetland Soil COI	Test Species	NOAEL (mg/kg bw/day)	Endpoint	Source
Metals				
Aluminum	mouse	34.3	reproduction, growth	Ondreicka et al. (1966)
Antimony	rat	1,489	growth, survival	Hext et al. (1999)
Arsenic	rat	2.6	growth	Byron et al. (1967)
Cadmium	rat	3.5	growth	Machemer and Lorke (1981)
Chromium	rat	1,466	growth, survival	Ivankovic and Preussman (1975)
Cobalt	rat	0.1[a]	growth	Chetty et al. (1979)
Copper	mink	18	reproduction	Aulerich et al. (1982)
Lead	rat	11	growth	Azar et al. (1973)
Mercury	rat	0.0017[b]	growth	Verschuuren et al. (1976)
Nickel	rat	na	reproduction	Ambrose et al. (1976)

[4] Both wetland soil and sediment were used to model the shrew diet, which consists of both terrestrial and aquatic prey. All chemicals detected in sediment (Table 2-11) were also detected in soil (Table 2-18).
[5] Both wetland soil and sediment were used to model the shrew diet, which consists of both terrestrial and aquatic prey.

Table 2-34. Selected Dietary-Dose NOAEL TRVs for the Terrestrial Mammal COPC Screen

Wetland Soil COI	Test Species	NOAEL (mg/kg bw/day)	Endpoint	Source
	rat	8.4	growth	
Selenium	rat	0.055	growth	Halverson et al. (1966)
Vanadium	rat	0.27[a]	growth	Adachi et al. (2000)
Zinc	rat	160	reproduction	Schlicker and Cox (1968)
PAHs				
2-Methylnaphthalene	mouse	54	growth	Murata et al. (1997)
Benzo(a)pyrene	mouse	2.0[b]	reproduction	MacKenzie and Angevine (1981)
Naphthalene	mouse	133	growth, survival	Shopp et al. (1984)
Total PAHs[c]	mouse	2.0[b]	reproduction	benzo(a)pyrene TRVs
Phthalates				
BEHP	mouse	44	reproduction	Tyl et al. (1988)
Butyl benzyl phthalate	rat	250	growth, reproduction	Tyl et al. (2004)
Di-n-butyl phthalate	rat	16[b]	reproduction	Wine et al. (1997)
Other SVOCs				
Benzoic acid	rat	80	growth, survival	Ignat'ev (1965), as cited in IRIS (EPA 2006)
Biphenyl	rat	50	survival	Ambrose et al. (1960), as cited in IRIS (EPA 2006)
Hexachlorobenzene	mink and ferret	0.026[b]	reproduction	Bleavins et al. (1984)
Phenol	rat	60	growth	Argus Research Laboratories (1997), as cited in IRIS (EPA 2006)[d]
	rat	60	reproduction	Charles River Laboratories (1988) and NTP (1983), as cited in IRIS (EPA 2006)[d]
PCBs				
Total PCBs[e]	mink	0.045[f]	reproduction	Brunstrom et al. (2001)
Pesticides				
delta-BHC[g]	rat	5.7[g]	growth, survival	Van Velsen et al. (1986)
Total DDTs[h]	rat	1.2	reproduction	Duby et al. (1971)
Methoxychlor	rat	17	growth, reproduction	Masutomi et al. (2003)
VOCs				
Acetone	rat	1,650	growth	Dietz et al. (1991)
Ethylbenzene	rat	250	growth	Mellert et al. (2007)

[a] NOAEL was estimated from an acute or subchronic LOAEL using a UF of 10.

[b] NOAEL was estimated from an chronic LOAEL using a UF of 5.

[c] Individual PAH COIs listed in Table 2-18 (acenaphthylene, acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, total benzofluoranthenes [benzo(b)fluoranthene and benzo(k)fluoranthene], benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, indeno(1,2,3,-c,d)pyrene, fluoranthene, fluorene, naphthalene, phenanthrene, and pyrene) were evaluated as part of the total PAH sum.

[d] Both studies had the same LOAEL and NOAEL.

[e] Individual PCB Aroclor COIs listed in Table 2-18 (Aroclor 1248, Aroclor 1254, and Aroclor 1260) were evaluated as part of the total PCB sum.

[f] NOAEL was estimated from a chronic LOAEL using a UF of 2; the rationale for using this UF is discussed in Section 4.4.

[g] TRVs for delta-BHC are based on TRVs reported for beta-BHC.

[h] Individual DDT metabolite COIs listed in Table 2-18 (2,4′-DDD, 2,4′-DDE, 2,4′-DDT, 4,4′-DDD, 4,4′-DDE, and 4,4′-DDT,) were evaluated as part of the total DDT sum.

BEHP – bis(2-ethylhexyl) phthalate
BHC – hexachlorocyclohexane
bw – body weight
COI – chemical of interest
COPC – chemical of potential concern
DDT – dichlorodiphenyltrichloroethane
IRIS – Integrated Risk Information System
LOAEL – lowest-observed-adverse-effect level
na – not available
NOAEL – no-observed-adverse-effect level
ns – not selected (NOAEL or LOAEL was not selected from this study)
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
SVOC – semivolatile organic compound
TRV – toxicity reference value
UF – uncertainty factor
VOC – volatile organic compound

Table 2-35. COIs without Mammal NOAEL TRVs

Wetland Soil COI	
Metals	
Barium	Manganese
Beryllium	Silver
PAHs	
Dibenzofuran	
Other SVOCs	
1,4-Dichlorobenzene	Benzyl alcohol
4-Methylphenol	Carbazole
Acetophenone	Pentachlorophenol
Benzaldehyde	
VOCs	
1,2,4-Trimethylbenzene	Methyl isobutyl ketone
Benzene	Tetrachloroethene
Carbon disulfide	Toluene
cis-1,2-Dichloroethene	Trichloroethene
p-Cymene	o-Xylene
Dichloromethane	m,p-Xylene
Methyl ethyl ketone	Total xylenes
TPH	
TPH-gasoline range	TPH-motor oil range (HCID)
TPH-diesel range (HCID)	TPH-motor oil range
TPH-diesel range	Total petroleum hydrocarbons

COI – chemical of interest
HCID – hydrocarbon identification
PAH – polycyclic aromatic hydrocarbon
SVOC – semivolatile organic compound
TPH – total petroleum hydrocarbons
VOC – volatile organic compound

Tables 2-36 and 2-37 present the results of the COPC screen for Eastern cottontail and shrew. Seven COPCs (i.e., aluminum, cobalt, copper, mercury,

selenium, vanadium, and total PAHs) were identified for Eastern cottontail and fourteen COPCs (i.e., aluminum, arsenic, cadmium, cobalt, copper, lead, mercury, nickel, selenium, vanadium, zinc, total PAHs, total PCBs, and total DDTs) were identified for shrew. These COPCs are evaluated further in the wildlife risk assessment for these ROCs (Section 5.3).

Table 2-36. Results of the Eastern Cottontail Dietary COPC Screen

Wetland Soil COI	Soil Concentration		BAF		Prey Tissue Concentration		Estimated Maximum Dose			COPC?
	C_{soil} [a]	Unit (dw)	Plant BAF	Unit	C_{plant} [b]	Unit (ww)	$Dose_{diet}$ [c]	NOAEL TRV	Unit	
Metals										
Aluminum	12,100	mg/kg	1	tiss dw/sed dw	2,500	mg/kg	**530**	34.3	mg/kg bw/day	**yes**
Antimony	8.4	mg/kg	$C_{plant} = e^{(0.938*LN(Csoil)-3.233)}$	tiss dw/sed dw	0.061	mg/kg	0.034	1,489	mg/kg bw/day	no
Arsenic	53.1	mg/kg	0.454	tiss dw/sed dw	5.1	mg/kg	1.1	2.6	mg/kg bw/day	no
Cadmium	4	mg/kg	1.359	tiss dw/sed dw	1.1	mg/kg	0.23	3.5	mg/kg bw/day	no
Chromium	149	mg/kg	0.041	tiss dw/sed dw	1.3	mg/kg	0.65	1466	mg/kg bw/day	no
Cobalt	34.3	mg/kg	0.0075	tiss dw/sed dw	0.054	mg/kg	**0.10**	0.1	mg/kg bw/day	**yes**
Copper	1,240	mg/kg	0.341	tiss dw/sed dw	89	mg/kg	**21**	18	mg/kg bw/day	**yes**
Lead	320	mg/kg	0.245	tiss dw/sed dw	16	mg/kg	4.0	11	mg/kg bw/day	no
Mercury	0.4	mg/kg	1.481	tiss dw/sed dw	0.12	mg/kg	**0.025**	0.0017	mg/kg bw/day	**yes**
Nickel	48	mg/kg	0.749	tiss dw/sed dw	7.5	mg/kg	1.6	8.4	mg/kg bw/day	no
Selenium	1.1	mg/kg	2.253	tiss dw/sed dw	0.52	mg/kg	**0.11**	0.055	mg/kg bw/day	**yes**
Vanadium	148	mg/kg	0.00485	tiss dw/sed dw	0.15	mg/kg	0.42	0.27	mg/kg bw/day	**yes**
Zinc	748	mg/kg	1.021	tiss dw/sed dw	160	mg/kg	34	160	mg/kg bw/day	no
PAHs										
2-Methylnaphthalene	2,880	mg/kg	12.2	tiss dw/sed dw	7,400	µg/kg	1,500	54,000	µg/kg bw/day	no
Benzo(a)pyrene	4,000	mg/kg	$C_{plant} = e^{(0.975*LN(Csoil)-2.0615)}$	tiss dw/sed dw	87	µg/kg	28	2,000	µg/kg bw/day	no
Naphthalene	4,210	mg/kg	12.2	tiss dw/sed dw	11,000	µg/kg	2,200	133,000	µg/kg bw/day	no
Total PAHs	69,000	mg/kg	6.15	tiss dw/sed dw	89,000	µg/kg	**18,000**	2,000	µg/kg bw/day	**yes**
Phthalates										
BEHP	9,100	µg/kg	0.00179	tiss dw/sed dw	3.4	µg/kg	24	44,000	µg/kg bw/day	no
Butyl benzyl phthalate	3,140	µg/kg	0.00179	tiss dw/sed dw	1.2	µg/kg	8.4	250,000	µg/kg bw/day	no
Di-n-butyl phthalate	2,400	µg/kg	0.128	tiss dw/sed dw	65	µg/kg	19	16,000	µg/kg bw/day	no
Other SVOCs										
Benzoic acid	28,000	µg/kg	1	tiss dw/sed dw	5,900	µg/kg	1,200	80,000	µg/kg bw/day	no

Table 2-36. Results of the Eastern Cottontail Dietary COPC Screen

Wetland Soil COI	Soil Concentration		BAF		Prey Tissue Concentration		Estimated Maximum Dose			COPC?
	C_{soil} [a]	Unit (dw)	Plant BAF	Unit	C_{plant} [b]	Unit (ww)	$Dose_{diet}$ [c]	NOAEL TRV	Unit	
Biphenyl	836	µg/kg	1	tiss dw/sed dw	180	µg/kg	38	50,000	µg/kg bw/day	no
Hexachlorobenzene	42	µg/kg	0.0189	tiss dw/sed dw	0.17	µg/kg	0.14	26	µg/kg bw/day	no
Phenol	498	µg/kg	5.55	tiss dw/sed dw	580	µg/kg	120	60,000	µg/kg bw/day	no
PCBs										
Total PCBs	4,200	µg/kg	0.00519	tiss dw/sed dw	4.6	µg/kg	12	45	µg/kg bw/day	no
Pesticides										
Total DDTs	46,000	µg/kg	$C_{plant} = e^{(0.7524*LN(Csoil)-2.5119)}$	tiss dw/sed dw	55	µg/kg	130	1,200	µg/kg bw/day	no
delta-BHC	3	µg/kg	0.157	tiss dw/sed dw	0.099	µg/kg	0.027	5,700	µg/kg bw/day	no
Methoxychlor	4.6	µg/kg	0.0585	tiss dw/sed dw	0.057	µg/kg	0.023	17,000	µg/kg bw/day	no
VOCs										
Acetone	2,300	µg/kg	53.3	tiss dw/sed dw	26,000	µg/kg	5,100	1,650,000	µg/kg bw/day	no
Ethylbenzene	3.4	µg/kg	0.348	tiss dw/sed dw	0.25	µg/kg	0.058	250,000	µg/kg bw/day	no

[a] C_{soil} is represented by maximum soil concentration.

[b] C_{plant} was estimated from C_{soil} and a plant BAF and converted to ww assuming percent moisture of 79%. C_{plant} (ww) = [BAF(dw/dw) x Max_{soil}] x (1 – F_M), where F_M = fraction moisture. See Appendix B for details on selected BAFs and assumptions used to estimate prey tissue concentrations.

[c] $Dose_{diet}$ was calculated using Equation 3-5, exposure parameters presented in Table 3-9, and assumption that diet is composed of 100% terrestrial plants.

BAF – bioaccumulation factor
BEHP – bis(2-ethylhexyl) phthalate
BHC – hexachlorocyclohexane
bw – body weight
COI – chemical of interest
COPC – chemical of potential concern
DDT – dichlorodiphenyltrichloroethane
dw – dry weight
LN – natural logarithm
NOAEL – no-observed-adverse-effect level
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
SVOC – semivolatile organic compound
TRV – toxicity reference value
VOC – volatile organic compound
ww – wet weight

BOLD identifies COPCs.

Table 2-37. Results of the Shrew Dietary COPC Screen

Wetland Soil COI	Soil Concentration		Sediment Concentration		BSAF		BAF		Prey Tissue Concentration			Estimated Maximum Dose			COPC?
	C_{soil} [a]	Unit	C_{sed} [b]	Unit	Aquatic Invert BSAF	Unit	Invert BAF	Unit	$C_{aquat\ invert}$ [c]	C_{invert} [d]	Unit	$Dose_{diet}$ [e]	NOAEL TRV	Unit	
Metals															
Aluminum	12,100	mg/kg dw	na[f]	na	1	tiss dw/sed dw	1	tiss dw/ sed dw	na	3,500	mg/kg ww	**2,200**[g]	34.3	mg/kg bw/day	**yes**
Antimony	8.4	mg/kg dw	1[h]	mg/kg dw	1	tiss dw/ sed dw	1	tiss dw/ sed dw	0.21	2.4	mg/kg ww	1.2	1,489	mg/kg bw/day	no
Arsenic	53.1	mg/kg dw	7	mg/kg dw	0.24	tiss dw/ sed dw	0.258	tiss dw/ sed dw	0.35	4.0	mg/kg ww	**2.7**	2.6	mg/kg bw/day	**yes**
Cadmium	4	mg/kg dw	2	mg/kg dw	3.438	tiss dw/ sed dw	17.105	tiss dw/ sed dw	1.4	20	mg/kg ww	**8.2**	3.5	mg/kg bw/day	**yes**
Chromium	149	mg/kg dw	34	mg/kg dw	0.206	tiss dw/ sed dw	1.099	tiss dw/ sed dw	1.5	47	mg/kg ww	22	1,466	mg/kg bw/day	no
Cobalt	34.3	mg/kg dw	15	mg/kg dw	1	tiss dw/ sed dw	0.122	tiss dw/ sed dw	3.2	1.2	mg/kg ww	**1.7**	0.1	mg/kg bw/day	**yes**
Copper	1,240	mg/kg dw	72	mg/kg dw	2.14	tiss dw/ sed dw	0.754	tiss dw/ sed dw	32	270	mg/kg ww	**140**	18	mg/kg bw/day	**yes**
Lead	320	mg/kg dw	56	mg/kg dw	0.331	tiss dw/ sed dw	3.342	tiss dw/ sed dw	3.9	310	mg/kg ww	**130**	11	mg/kg bw/day	**yes**
Mercury	0.4	mg/kg dw	0.2	mg/kg dw	1.204	tiss dw/ sed dw	5.231	tiss dw/ sed dw	0.051	0.61	mg/kg ww	**0.26**	0.0017	mg/kg bw/day	**yes**
Nickel	48	mg/kg dw	31	mg/kg dw	1.313	tiss dw/ sed dw	1.656	tiss dw/ sed dw	8.5	23	mg/kg ww	**11**	8.4	mg/kg bw/day	**yes**
Selenium	1.1	mg/kg dw	4[h]	mg/kg dw	1	tiss dw/ sed dw	1.798	tiss dw/ sed dw	0.84	0.57	mg/kg ww	**0.39**	0.055	mg/kg bw/day	**yes**
Vanadium	148	mg/kg dw	74	mg/kg dw	1	tiss dw/ sed dw	0.042	tiss dw/ sed dw	16	1.8	mg/kg ww	**6.5**	0.27	mg/kg bw/day	**yes**
Zinc	748	mg/kg dw	229	mg/kg dw	3.473	tiss dw/ sed dw	5.766	tiss dw/ sed dw	170	1,300	mg/kg ww	**550**	160	mg/kg bw/day	**yes**
PAHs															
2-Methylnaphthalene	2,880	µg/kg dw	0.61	mg/kg OC	3.19	tiss lipid/ sed OC	4.4	tiss dw/ sed dw	23	3,700	µg/kg ww	1,500	54,000	µg/kg bw/day	no
Benzo(a)pyrene	4,000	µg/kg dw	1.3	mg/kg OC	0.383	tiss lipid/ sed OC	1.33	tiss dw/ sed dw	6.0	1,500	µg/kg ww	670	2,000	µg/kg bw/day	no

Table 2-37. Results of the Shrew Dietary COPC Screen

Wetland Soil COI	Soil Concentration		Sediment Concentration		BSAF		BAF		Prey Tissue Concentration			Estimated Maximum Dose			COPC?
	C_{soil} [a]	Unit	C_{sed} [b]	Unit	Aquatic Invert BSAF	Unit	Invert BAF	Unit	$C_{aquat\ invert}$ [c]	C_{invert} [d]	Unit	$Dose_{diet}$ [e]	NOAEL TRV	Unit	
Naphthalene	4,210	µg/kg dw	1.2	mg/kg OC	0.588	tiss lipid/ sed OC	4.4	tiss dw/ sed dw	8.5	5400	µg/kg ww	2,200	133,000	µg/kg bw/day	no
Total PAHs	69,000	µg/kg dw	19.8	mg/kg OC	0.923	tiss lipid/ sed OC	2.87	tiss dw/ sed dw	220	57,000	µg/kg ww	**24,000**	2,000	µg/kg bw/day	**yes**
Phthalates															
BEHP	9,100	µg/kg dw	na[f]	na	48.5	na	1	tiss dw/ sed dw	na	2,600	µg/kg ww	1,600[g]	44,000	µg/kg bw/day	no
Butyl benzyl phthalate	3,140	µg/kg dw	na[f]	na	48.5	na	1	tiss dw/ sed dw	na	910	µg/kg ww	580[g]	250,000	µg/kg bw/day	no
Di-n-butyl phthalate	2,400	µg/kg dw	na[f]	na	48.5	na	1	tiss dw/ sed dw	na	700	µg/kg ww	440[g]	16,000	µg/kg bw/day	no
Other SVOCs															
Benzoic acid	28,000	µg/kg dw	na[f]	na	na	na	1	tiss dw/ sed dw	na	8,100	µg/kg ww	5,100[g]	80,000	µg/kg bw/day	no
Biphenyl	836	µg/kg dw	na[f]	na	na	na	1	tiss dw/ sed dw	na	240	µg/kg ww	150[g]	50,000	µg/kg bw/day	no
Hexachlorobenzene	42	µg/kg dw	0.17[h,i]	mg/kg OC	1	tiss lipid/ sed OC	1	tiss dw/ sed dw	2.0	12	µg/kg ww	5.9	26	µg/kg bw/day	no
Phenol	498	µg/kg dw	na[f]	na	1	na	1	tiss dw/ sed dw	na	140	µg/kg ww	89[g]	60,000	µg/kg bw/day	no
PCBs															
Total PCBs	4,200	µg/kg dw	1.83	mg/kg OC	2.57	tiss lipid/ sed OC	8.91	tiss dw/ sed dw	56	11,000	µg/kg ww	**4,400**	45	µg/kg bw/day	**yes**
Pesticides															
Total DDTs	46,000	µg/kg dw	3.7	mg/kg OC	4.52	tiss lipid/ sed OC	11.2	tiss dw/ sed dw	200	150,000	µg/kg ww	**60,000**	1,200	µg/kg bw/day	**yes**
delta-BHC	3	µg/kg dw	0.17[h,i]	mg/kg OC	1	tiss lipid/ sed OC	1	tiss dw/ sed dw	2.0	0.87	µg/kg ww	0.74	5,700	µg/kg bw/day	no

Table 2-37. Results of the Shrew Dietary COPC Screen

Wetland Soil COI	Soil Concentration		Sediment Concentration		BSAF		BAF		Prey Tissue Concentration			Estimated Maximum Dose			COPC?
	C_{soil} [a]	Unit	C_{sed} [b]	Unit	Aquatic Invert BSAF	Unit	Invert BAF	Unit	$C_{aquatic\ invert}$ [c]	C_{invert} [d]	Unit	$Dose_{diet}$ [e]	NOAEL TRV	Unit	
Methoxychlor	4.6	µg/kg dw	1.7[h,i]	mg/kg OC	1	tiss lipid/ sed OC	1	tiss dw/ sed dw	20	1.3	µg/kg ww	4.0	17,000	µg/kg bw/day	no
VOCs															
Acetone	2,300	µg/kg dw	14	mg/kg OC	1	tiss lipid/ sed OC	1	tiss dw/ sed dw	170	370	µg/kg ww	341	1,650,000	µg/kg bw/day	no
Ethylbenzene	3.4	µg/kg dw	0.12[h,i]	mg/kg OC	1	tiss lipid/ sed OC	1	tiss dw/ sed dw	1.4	0.99	µg/kg ww	0.70	250,000	µg/kg bw/day	no

[a] C_{soil} is represented by maximum soil concentration.

[b] C_{sed} is represented by maximum sediment concentration.

[c] $C_{aquatic\ invert}$ was estimated from C_{sed} (either as a dw concentration or an OC-normalized concentration) and an aquatic benthic invertebrate BSAF. When the sediment concentration was dw, the following equation was used: $C_{aquatic\ invert}$ (ww) = (BSAF x Max_{sed}) x (1 – F_M), where F_M = fraction moisture. When the sediment concentration was OC-normalized, the following equation was used: $C_{aquatic\ invert}$ (ww) = (BSAF x Max_{sed}) x F_L, where F_L = fraction lipid. $C_{aquatic\ invert}$ was converted to ww assuming a moisture content of 79% or a lipid content of 1.2%. See Appendix B for details on selected BSAFs and assumptions used to estimate prey tissue concentrations.

[d] C_{invert} was estimated from C_{soil} and an invertebrate BAF and converted to ww assuming a moisture content of 71%. C_{invert} (ww) = [BAF(dw/dw) x Max_{soil}] x (1 – F_M), where F_M = fraction moisture. See Appendix B for details on selected BAFs and assumptions used to estimate prey tissue concentrations.

[e] $Dose_{diet}$ was calculated using Equations 3-1 and 3-5, exposure parameters presented in Table 3-9, and assumption that diet is composed of 70% (30% earthworms and 40% terrestrial invertebrates) and 30% aquatic invertebrates.

[f] Chemical was not analyzed in sediment.

[g] $Dose_{diet}$ estimated assuming 100% terrestrial prey (because no sediment data available to model aquatic prey).

[h] C_{sed} is represented by maximum RL (chemical not detected in sediment).

[i] Maximum RL was converted into mg/kg OC using the average sediment OC measured in Force Lake (7.1%).

BAF – bioaccumulation factor
BEHP – bis(2-ethylhexyl) phthalate
BHC – hexachlorocyclohexane
BSAF – biota-sediment accumulation factor
bw – body weight
COI – chemical of interest
COPC – chemical of potential concern
DDT – dichlorodiphenyltrichloroethane
dw – dry weight
na – not available
NOAEL – no observed adverse effect level
OC – organic carbon
PAH – polycyclic aromatic hydrocarbon \
PCB – polychlorinated biphenyl
SVOC – semivolatile organic compound
TRV – toxicity reference value
VOC – volatile organic compound
ww – wet weight

BOLD identifies COPCs.

2.6.5 Summary of COPCs

Table 2-38 presents all COPCs for aquatic benthic and terrestrial invertebrates. Table 2-39 identifies the ROC-COPC pairs for all fish and wildlife COPCs.

Table 2-38. Summary of Invertebrate COPCs

COPC	Aquatic Benthic Invertebrate COPC[a]	Terrestrial Invertebrate COPC[b]
Metals		
Aluminum		X
Arsenic	X	
Barium	X	X
Cadmium	X	
Chromium		X
Cobalt		
Copper	X	X
Lead	X	
Manganese		X
Mercury	X	X
Nickel	X	
Selenium		
Vanadium		
Zinc	X	X
PAHs		
Benzo(a)anthracene	X	
Benzo(a)pyrene	X	
Chrysene	X	
Fluoranthene	X	
Phenanthrene	X	
Pyrene	X	
Total HPAHs		X
Total PAHs		
PCBs		
Total PCBs	X	
Pesticides		
2,4′-DDD	X	
4,4′-DDD	X	
4,4′-DDE	X	
Total DDTs	X	

[a] Aquatic benthic invertebrate COPCs based on screening of sediment and surface water as presented in Tables 2-15 and 2-17, respectively.

[b] Terrestrial invertebrate COPCs based on screening of soils as presented in Table 2-21.

COPC – chemical of potential concern
DDD – dichlorodiphenyldichloroethane
DDE – dichlorodiphenyldichloroethylene
DDT – dichlorodiphenyltrichloroethane
HPAH – high-molecular-weight polycyclic aromatic hydrocarbon
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl

Table 2-39. Summary of Fish and Wildlife ROC-COPC Pairs

	Aquatic ROCs				Terrestrial ROCs		
COPC	**Pumpkin-seed[a]**	**Brown Bullhead[b]**	**Ruddy Duck[c]**	**Great Blue Heron[d]**	**Red-Tailed Hawk[e]**	**Eastern Cotton-tail[f]**	**Shrew[g]**
Metals							
Aluminum					X	X	X
Arsenic							X
Barium	X	X					
Cadmium	X	X					X
Cobalt						X	X
Copper	X	X				X	X
Lead							X
Mercury			X			X	X
Nickel							X
Selenium						X	X
Vanadium	X	X	X	X		X	X
Zinc							X
PAHs							
Total PAHs						X	X
PCBs							
Total PCBs	X	X					X
Pesticides							
Total DDTs			X	X	X		X

[a] COPCs based on screening of surface water, fish tissue, and ROC-specific diet, as presented in Tables 2-17,2-23, and 2-25, respectively.
[b] COPCs based on screening of surface water, fish tissue, and ROC-specific diet, as presented in Tables 2-17,2-23, and 2-26, respectively.
[c] COPCs based on screening of ROC-specific diet, as presented in Table 2-29.
[d] COPCs based on screening of ROC-specific diet, as presented in Table 2-30.
[e] COPCs based on screening of ROC-specific diet, as presented in Table 2-33.
[f] COPCs based on screening of ROC-specific diet, as presented in Table 2-36.
[g] COPCs based on screening of ROC-specific diet, as presented in Table 2-37.

COPC – chemical of potential concern
DDT – dichlorodiphenyltrichloroethane
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
ROC – receptor of concern

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ATTACHMENT 1: ERA COPC SCREENING TEXT (SECTION 2.6 OF THE ERA)

2.6 COPC Screen

A risk-based screen was conducted for each ROC to identify a list of COPCs that may cause adverse effects; these COPCs are further assessed in the ERA. The COPC screen was conducted in accordance with the methods outlined in the RI/FS Work Plan (Bridgewater et al. 2008) and Risk Assessment Scoping Memorandum (Windward and Bridgewater 2008). COPCs were determined separately for aquatic benthic invertebrates, terrestrial invertebrates, fish ROCs, bird ROCs, and mammal ROCs, as discussed below.

2.6.1 Aquatic Benthic Invertebrates

This section presents the COPC screen for aquatic benthic invertebrates, which is summarized in Figure 2-4.

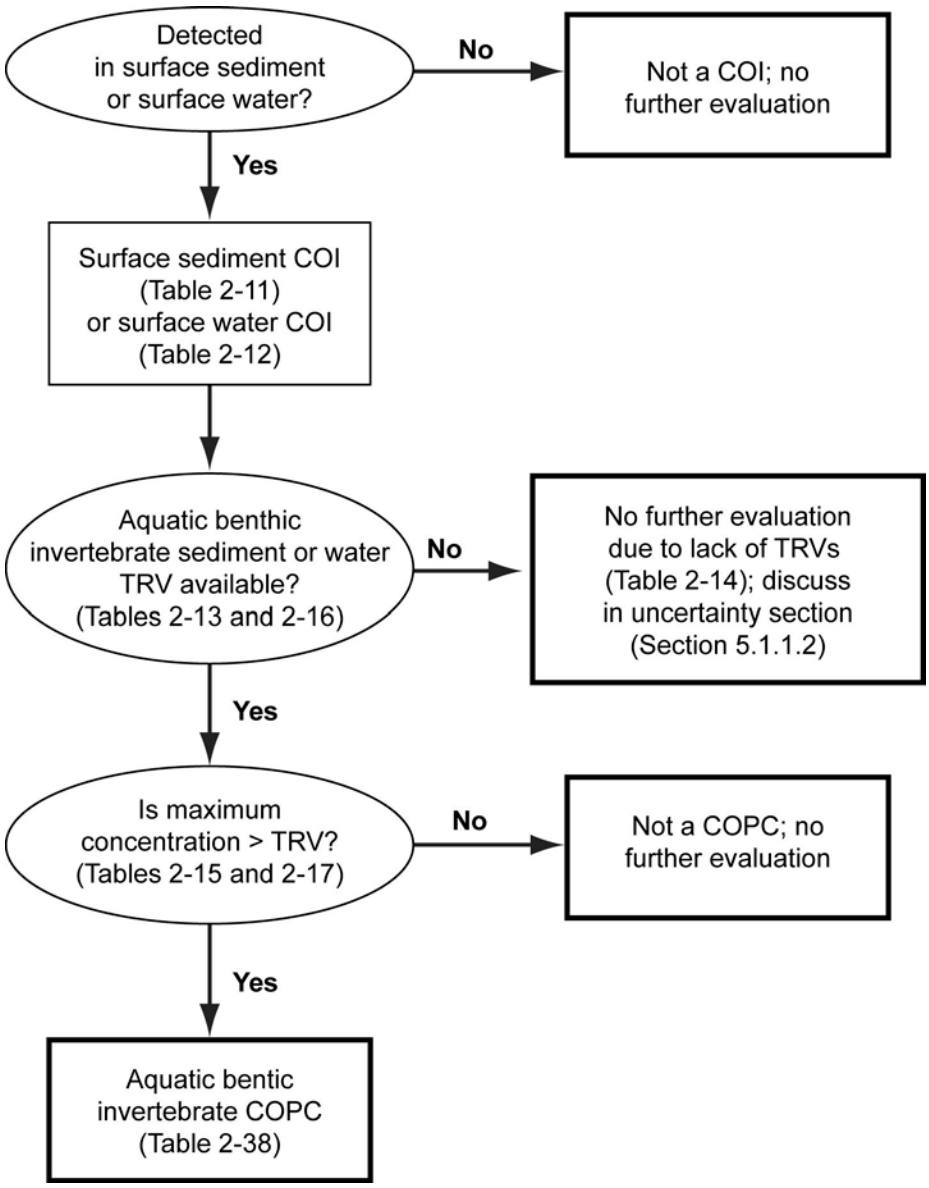

Figure 2-4. COPC Screening Process for Aquatic Benthic Invertebrates

2.6.1.1 COIs for Aquatic Benthic Invertebrates

The first step of the COPC screening process for aquatic benthic invertebrates was to generate a list of chemicals of interest (COIs). Surface sediment and surface water COIs for aquatic benthic invertebrates were defined as any analyte detected in at least one sample in a given media (e.g., an analyte detected in sediment was a sediment COI).

Tables 2-11 and 2-12 present the surface sediment and surface water COIs. These COIs are screened in Sections 2.6.1.2 and 2.6.1.3 to identify COPCs for aquatic benthic invertebrates.

Table 2-11. Chemicals Detected in Surface Sediment and Thus Identified as COIs

Surface Sediment COI	
Metals	
Arsenic	Lead
Barium	Mercury
Cadmium	Nickel
Chromium	Vanadium
Cobalt	Zinc
Copper	
PAHs	
2-Methylnaphthalene	Dibenzo(a,h)anthracene
Acenaphthene	Dibenzofuran
Acenaphthylene	Fluoranthene
Anthracene	Fluorene
Benzo(a)anthracene	Indeno(1,2,3-cd)pyrene
Benzo(a)pyrene	Naphthalene
Benzo(b)fluoranthene	Phenanthrene
Benzo(g,h,i)perylene	Pyrene
Benzo(k)fluoranthene	Total HPAHs
Total benzofluoranthenes	Total LPAHs
Chrysene	Total PAHs
PCBs	
Aroclor 1254	Total PCBs
Aroclor 1260	
Pesticides	
2,4′-DDD	4,4′-DDE
4,4′-DDD	Total DDTs
VOCs	
Acetone	Methyl ethyl ketone
Carbon disulfide	Toluene
TPH	
TPH-gasoline range	TPH-motor oil range
TPH-diesel range	Total petroleum hydrocarbons

COI – chemical of interest
DDD – dichlorodiphenyldichloroethane
DDE – dichlorodiphenyldichloroethylene
DDT – dichlorodiphenyltrichloroethane
HPAH – high-molecular-weight polycyclic aromatic hydrocarbon
LPAH – low-molecular-weight polycyclic aromatic hydrocarbon
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
SVOC – semivolatile organic compound
TPH – total petroleum hydrocarbons
VOC – volatile organic compound

Table 2-12. Chemicals Detected in Surface Water and Thus Identified as COIs

Surface Water COI	
Metals	
Arsenic	Copper
Barium	
VOCs	
Acetone	

COI – chemical of interest
VOC – volatile organic compound

2.6.1.2 Surface Sediment COPC Screen for Aquatic Benthic Invertebrates

In the second step, COPCs for aquatic benthic invertebrates in surface sediment were identified by comparing maximum detected COI concentrations in surface sediment to aquatic benthic invertebrate-specific sediment screening thresholds. COIs with maximum detected concentrations greater than screening thresholds were considered COPCs for aquatic benthic invertebrates. Sediment screening thresholds protective of aquatic benthic invertebrates were selected as the lowest of the following thresholds:

- Threshold effects levels (TELs) reported by Smith et al. (1996)
- Threshold effects concentrations (TECs) reported by MacDonald et al. (2000)

The lowest sediment screening threshold for each COI is presented in Table 2-13. Appendix A provides a table of all sediment thresholds compiled from the above sources. Sediment COIs with no screening thresholds are presented in Table 2-14; these chemicals were not addressed further in the ERA but are noted in the uncertainty analysis.

Table 2-13. Aquatic Benthic Invertebrate Sediment Screening Thresholds

Surface Sediment COI	Screening Threshold	Unit (dw)	Source
Metals			
Arsenic	5.9	mg/kg	Smith et al. (1996)
Cadmium	0.596	mg/kg	Smith et al. (1996)
Chromium	37.3	mg/kg	Smith et al. (1996)
Copper	31.6	mg/kg	MacDonald et al. (2000)
Lead	35	mg/kg	Smith et al. (1996)
Mercury	0.174	mg/kg	Smith et al. (1996)
Nickel	18	mg/kg	Smith et al. (1996)
Zinc	121	mg/kg	MacDonald et al. (2000)
PAHs			
Anthracene	57.2	µg/kg	MacDonald et al. (2000)
Benzo(a)anthracene	31.7	µg/kg	Smith et al. (1996)

Table 2-13. Aquatic Benthic Invertebrate Sediment Screening Thresholds

Surface Sediment COI	Screening Threshold	Unit (dw)	Source
Benzo(a)pyrene	31.9	µg/kg	Smith et al. (1996)
Chrysene	57.1	µg/kg	Smith et al. (1996)
Dibenzo(a,h)anthracene	33	µg/kg	MacDonald et al. (2000)
Fluoranthene	111	µg/kg	Smith et al. (1996)
Fluorene	77.4	µg/kg	MacDonald et al. (2000)
Naphthalene	176	µg/kg	MacDonald et al. (2000)
Phenanthrene	41.9	µg/kg	Smith et al. (1996)
Pyrene	53	µg/kg	Smith et al. (1996)
Total PAHs[a]	1,610	µg/kg	MacDonald et al. (2000)
PCBs			
Total PCBs[b]	34.1	µg/kg	Smith et al. (1996)
Pesticides			
2,4′-DDD	3.54	µg/kg	Smith et al. (1996)
4,4′-DDD	3.54	µg/kg	Smith et al. (1996)
4,4′-DDE	1.42	µg/kg	Smith et al. (1996)
Total DDTs	5.28	µg/kg	MacDonald et al. (2000)

[a] Individual PAH COIs listed in Table 2-11 (acenaphthylene, acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, total benzofluoranthenes [benzo(b)fluoranthene and benzo(k)fluoranthene], benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, indeno(1,2,3,-c,d)pyrene, fluoranthene, fluorene, naphthalene, phenanthrene, and pyrene) were evaluated as part of the total PAH sum.

[b] Individual PCB Aroclor COIs listed in Table 2-11 (Aroclor 1254 and Aroclor 1260) were evaluated as part of the total PCB sum.

COI – chemical of interest
DDD – dichlorodiphenyldichloroethane
DDE – dichlorodiphenyldichloroethylene
DDT – dichlorodiphenyltrichloroethane
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl

Table 2-14. COIs with No Aquatic Benthic Invertebrate Screening Threshold

Surface Sediment COI	
Metals	
Barium	Vanadium
Cobalt	
PAHs	
2-Methylnaphthalene	Dibenzofuran
VOCs	
Acetone	Methyl ethyl ketone
Carbon disulfide	Toluene
TPH	
TPH-gasoline range	TPH-motor oil range
TPH-diesel range	Total petroleum hydrocarbons

COI – chemical of interest
PAH – polycyclic aromatic hydrocarbon
TPH – total petroleum hydrocarbons
VOC – volatile organic compound

Table 2-15 presents the results of the surface sediment screen for aquatic benthic invertebrates. Eighteen COPCs (i.e., arsenic, cadmium, copper, lead, mercury, nickel, zinc, benzo(a)anthracene, benzo(a)pyrene, chrysene, fluoranthene, phenanthrene, pyrene, total PCBs, 2,4′-DDD, 4,4′-DDD, 4,4′-DDE, and total DDTs) were identified because maximum surface sediment concentrations were greater than the lowest sediment screening thresholds. These COPCs are evaluated further in the aquatic benthic invertebrate risk assessment (Section 5.1.1).

Table 2-15. Aquatic Benthic Invertebrate COPC Screen Results for Surface Sediment

Surface Sediment COI	Unit (dw)	Maximum Concentration	Screening Threshold	COPC?
Metals				
Arsenic	mg/kg	7	5.9	**yes**
Cadmium	mg/kg	2	0.596	**yes**
Chromium	mg/kg	34	37.3	no
Copper	mg/kg	72	31.6	**yes**
Lead	mg/kg	56	35	**yes**
Mercury	mg/kg	0.2	0.174	**yes**
Nickel	mg/kg	31	18	**yes**
Zinc	mg/kg	229	121	**yes**
PAHs				
Anthracene	µg/kg	26	57.2	no
Benzo(a)anthracene	µg/kg	74	31.7	**yes**
Benzo(a)pyrene	µg/kg	83	31.9	**yes**
Chrysene	µg/kg	110	57.1	**yes**
Dibenzo(a,h)anthracene	µg/kg	6.5	33	no
Fluoranthene	µg/kg	190	111	**yes**
Fluorene	µg/kg	26	77.4	no
Naphthalene	µg/kg	61	176	no
Phenanthrene	µg/kg	120	41.9	**yes**
Pyrene	µg/kg	180	53	**yes**
Total PAHs	µg/kg	1,060	1,610	no
PCBs				
Total PCBs	µg/kg	131	34.1	**yes**
Pesticides				
2,4′-DDD	µg/kg	61	3.54	**yes**
4,4′-DDD	µg/kg	47	3.54	**yes**
4,4′-DDE	µg/kg	150	1.42	**yes**
Total DDTs	µg/kg	250	5.28	**yes**

COI – chemical of interest
COPC – chemical of potential concern
DDD – dichlorodiphenyldichloroethane
DDE – dichlorodiphenyldichloroethylene
DDT – dichlorodiphenyltrichloroethane
dw – dry weight
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
Bold identifies COPCs.

2.6.1.3 Surface Water COPC Screen for Aquatic Benthic Invertebrates

COPCs for aquatic benthic invertebrates were also determined using surface water data. Surface water COPCs were identified by comparing maximum surface water concentrations to chronic water screening thresholds. Surface water COIs with maximum detected concentrations greater than the water screening thresholds were considered COPCs for aquatic benthic invertebrates.

Chronic water screening thresholds protective of aquatic species (including aquatic invertebrates) were selected based on the lower of national water quality criteria protective of freshwater organisms (EPA ambient water quality criteria [AWQC]) or proposed Oregon water quality criteria (Oregon Administrative Rule [OAR] 340-41, Table 33). For those COIs for which neither AWQC nor Oregon water quality criteria were available, the Tier 2 values provided by Suter and Tsao (1996) were used. Water screening thresholds for surface water COIs are presented in Table 2-16. Appendix A also provides a table of the water thresholds.

Table 2-16. Selected Chronic Water Screening Thresholds

Surface Water COI	Unit	Screening Threshold	Source
Metals			
Arsenic	µg/L	150[a]	EPA AWQC (2009)
Barium	µg/L	4[b]	Tier II (Suter and Tsao 1996)
Copper	µg/L	1.3[a, c]	EPA AWQC (2009)
VOCs			
Acetone	µg/L	1,500	Tier II (Suter and Tsao 1996)

[a] Threshold expressed as the dissolved metal concentration.

[b] Threshold expressed as the total metal concentration.

[c] Threshold was hardness adjusted based on the average Force Lake hardness (10.7 mg/L $CaCO_3$).

AWQC – ambient water quality criteria
COI – chemical of interest
EPA – US Environmental Protection Agency
VOC – volatile organic compound

Table 2-17 presents the results of the surface water screen. Two COPCs (i.e., barium and copper) were identified and are evaluated further in the aquatic benthic invertebrate risk assessment (Section 5.1.1).

Table 2-17. COPC Screen Results for Surface Water

Surface Water COI	Unit	Maximum Concentration	Screening Threshold	COPC?
Metals				
Arsenic (dissolved)	µg/L	1	150	no
Barium (total)	µg/L	31	4	**yes**
Copper (dissolved)	µg/L	4.0	1.3	**yes**
VOCs				
Acetone	µg/L	6.5	1,500	no

COI – chemical of interest
COPC – chemical of potential concern
VOC – volatile organic compound
Bold identifies COPCs.

2.6.2 Terrestrial Invertebrates

This section presents the COPC screen for terrestrial invertebrates, which is summarized in Figure 2-5.

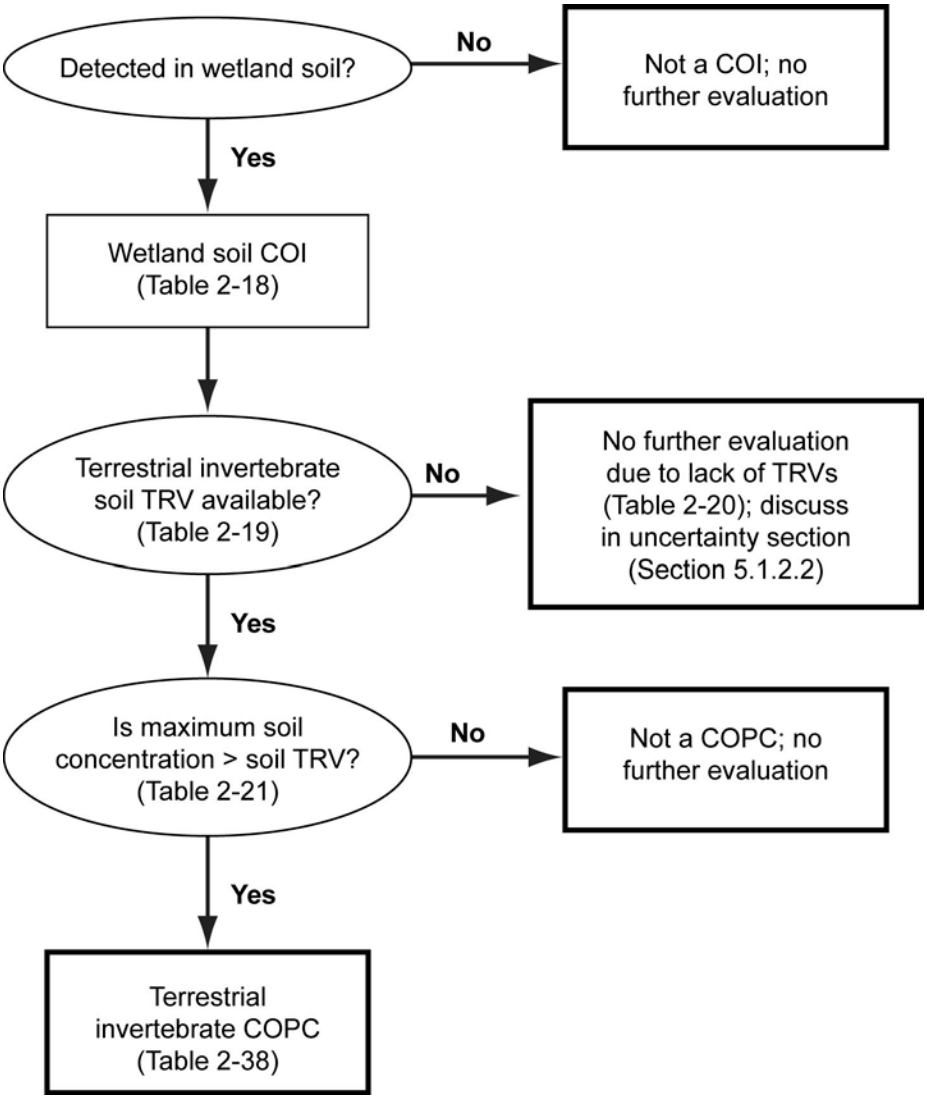

Figure 2-5. COPC Screening Process for Terrestrial Invertebrates

2.6.2.1 COIs for Terrestrial Invertebrates

The first step of the COPC screening process for terrestrial invertebrates was to generate a list of chemicals of interest (COIs). Wetland soil COIs for terrestrial invertebrates were defined as any analyte detected in at least one wetland soil sample. Table 2-18 presents the wetland soil COIs for terrestrial benthic invertebrates.

Table 2-18. Chemicals Detected in Wetland Soil and Thus Identified as COIs

Wetland Soil COI[a]	
Metals	
Aluminum	Lead
Antimony	Manganese
Arsenic	Mercury

Table 2-18. Chemicals Detected in Wetland Soil and Thus Identified as COIs

Wetland Soil COI[a]	
Barium	Nickel
Beryllium	Selenium
Cadmium	Silver
Chromium	Vanadium
Cobalt	Zinc
Copper	
PAHs	
2-Methylnaphthalene	Dibenzo(a,h)anthracene
Acenaphthene	Dibenzofuran
Acenaphthylene	Fluoranthene
Anthracene	Fluorene
Benzo(a)anthracene	Indeno(1,2,3-cd)pyrene
Benzo(a)pyrene	Naphthalene
Benzo(b)fluoranthene	Phenanthrene
Benzo(g,h,i)perylene	Pyrene
Benzo(k)fluoranthene	Total HPAHs
Total benzofluoranthenes	Total LPAHs
Chrysene	Total PAHs
Phthalates	
Bis(2-ethylhexyl) phthalate	Di-n-butyl phthalate
Butyl benzyl phthalate	
Other SVOCs	
1,4-Dichlorobenzene	Biphenyl
4-Methylphenol	Carbazole
Acetophenone	Hexachlorobenzene
Benzaldehyde	Pentachlorophenol
Benzoic acid	Phenol
Benzyl alcohol	
PCBs	
Aroclor 1248	Aroclor 1260
Aroclor 1254	Total PCBs
Pesticides	
2,4′-DDD	4,4′-DDT
2,4′-DDE	Total DDTs
2,4′-DDT	delta-BHC
4,4′-DDD	Methoxychlor
4,4′-DDE	
VOCs	
1,2,4-Trimethylbenzene	Methyl ethyl ketone
Acetone	Methyl isobutyl ketone

Table 2-18. Chemicals Detected in Wetland Soil and Thus Identified as COIs

Wetland Soil COI[a]	
Benzene	Tetrachloroethene
Carbon disulfide	Toluene
cis-1,2-Dichloroethene	Trichloroethene
p-Cymene	o-Xylene
Dichloromethane	m,p-Xylene
Ethylbenzene	Total xylene
TPH	
TPH-gasoline range	TPH-motor oil range (HCID)
TPH-diesel range (HCID)	TPH-motor oil range
TPH-diesel range	Total petroleum hydrocarbons

[a] Calcium, iron, magnesium, potassium, and sodium were detected historically; however, these analytes were not evaluated as COIs because they were not analyzed as part of Phase 1 or Phase 2 sampling events for the RI and are not expected to be toxic to ecological ROCs.

BHC –hexachlorocyclohexane
COI – chemical of interest
DDD – dichlorodiphenyldichloroethane
DDE – dichlorodiphenyldichloroethylene
DDT – dichlorodiphenyltrichloroethane
HCID – hydrocarbon identification
HPAH – high-molecular-weight polycyclic aromatic hydrocarbon
LPAH – low-molecular-weight polycyclic aromatic hydrocarbon
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
RI – remedial investigation
SVOC – semivolatile organic compound
TPH – total petroleum hydrocarbons
VOC – volatile organic compound

2.6.2.2 COPC Screen for Terrestrial Invertebrates

In the second step, COPCs for terrestrial invertebrates were identified in wetland soil by comparing maximum detected COI concentrations in soil to terrestrial invertebrate-specific screening thresholds. COIs with maximum detected concentrations greater than soil screening thresholds were considered COPCs for terrestrial invertebrates. Terrestrial invertebrate-specific soil screening thresholds were selected as the lowest terrestrial invertebrate-specific threshold from the following sources:

- EPA Ecological Soil Screening Levels (SSLs) (2007a) protective of soil invertebrates
- Oak Ridge National Laboratory (ORNL) soil data for invertebrates (Efroymson et al. 1997)
- Oregon Department of Environmental Quality (DEQ) soil screening level values protective of terrestrial invertebrates (2001)

The lowest soil screening threshold for each COI is presented in Table 2-19. Appendix A provides a table of all soil screening values compiled from the above sources. Soil COIs with no screening values are presented in Table 2-20; these chemicals were not addressed further in the ERA but are noted in the uncertainty analysis.

Table 2-19. Terrestrial Invertebrate Soil Screening Thresholds

Wetland Soil COI	Screening Threshold	Unit (dw)	Source
Metals			
Aluminum	600	mg/kg	DEQ (2001)
Antimony	78	mg/kg	Ecological SSL (EPA 2005a)
Arsenic	60	mg/kg	DEQ (2001); Efroymson et al. (1997)
Barium	330	mg/kg	Ecological SSL (EPA 2005b)
Beryllium	40	mg/kg	Ecological SSL (EPA 2005c)
Cadmium	20	mg/kg	DEQ (2001); Efroymson et al. (1997)
Chromium	0.4	mg/kg	DEQ (2001); Efroymson et al. (1997)
Cobalt	1,000	mg/kg	DEQ (2001)
Copper	50	mg/kg	DEQ (2001); Efroymson et al. (1997)
Lead	500	mg/kg	DEQ (2001); Efroymson et al. (1997)
Manganese	100	mg/kg	DEQ (2001)
Mercury	0.1	mg/kg	DEQ (2001); Efroymson et al. (1997)
Nickel	200	mg/kg	DEQ (2001); Efroymson et al. (1997)
Selenium	4.1	mg/kg	Ecological SSL (EPA 2007c)
Silver	50	mg/kg	DEQ (2001)
Zinc	120	mg/kg	Ecological SSL (EPA 2007d)
PAHs[a]			
Total LPAHs[a]	29,000	µg/kg	Ecological SSL (EPA 2007b)
Total HPAHs[b]	18,000	µg/kg	Ecological SSL (EPA 2007b)
Other SVOCs			
1,4-Dichlorobenzene	20,000	µg/kg	DEQ (2001); Efroymson et al. (1997)
Hexachlorobenzene	1,000,000	µg/kg	DEQ (2001)
Pentachlorophenol	4,000	µg/kg	DEQ (2001)
Phenol	30,000	µg/kg	DEQ (2001); Efroymson et al. (1997)

[a] Individual PAH COIs listed in Table 2-18 (acenaphthylene, acenaphthene, anthracene, fluorene, naphthalene, and phenanthrene) were evaluated as part of the total LPAH sum.

[b] Individual PAH COIs listed in Table 2-18 (benzo(a)anthracene, benzo(a)pyrene, total benzofluoranthenes [benzo(b)fluoranthene and benzo(k)fluoranthene], benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, indeno(1,2,3,-c,d)pyrene, fluorene, and pyrene) were evaluated as part of the total HPAH sum.

COI – chemical of interest
DEQ – Oregon Department of Environmental Quality
dw – dry weight
EPA – US Environmental Protection Agency
HPAH – high-molecular-weight polycyclic aromatic hydrocarbon
LPAH – low-molecular-weight polycyclic aromatic hydrocarbon
PAH – polycyclic aromatic hydrocarbon
SSL – soil screening level
SVOC – semivolatile organic compound

Table 2-20. COIs with No Terrestrial Invertebrate Screening Threshold

Wetland Soil COI	
Metals	
Vanadium	
Phthalates	
Bis(2-ethylhexyl) phthalate	Di-n-butyl phthalate
Butyl benzyl phthalate	
PAHs	
2-Methylnaphthlene	Dibenzofuran
Other SVOCs	
4-Methylphenol	Benzyl alcohol
Acetophenone	Biphenyl
Benzaldehyde	Carbazole
Benzoic acid	
PCBs	
Aroclor 1248	Aroclor 1260
Aroclor 1254	Total PCBs
Pesticides	
2,4′-DDD	4,4′-DDT
2,4′-DDE	Total DDTs
2,4′-DDT	delta-BHC
4,4′-DDD	Methoxychlor
4,4′-DDE	
VOCs	
1,2,4-Trimethylbenzene	Methyl ethyl ketone
Acetone	Methyl isobutyl ketone
Benzene	Tetrachloroethene
Carbon disulfide	Toluene
cis-1,2-Dichloroethene	Trichloroethene
p-Cymene	o-Xylene
Dichloromethane	m,p-Xylene
Ethylbenzene	Total xylene
TPH	
TPH-gasoline range	TPH-motor oil range (HCID)
TPH-diesel range (HCID)	TPH-motor oil range
TPH-diesel range	Total petroleum hydrocarbons

BHC – hexachlorocyclohexane
COI – chemical of interest
DDD – dichlorodiphenyldichloroethane
DDE – dichlorodiphenyldichloroethylene
DDT – dichlorodiphenyltrichloroethane
HCID – hydrocarbon identification
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
SVOC – semivolatile organic compound
TPH – total petroleum hydrocarbons
VOC – volatile organic compound

Table 2-21 presents the results of the wetland soil screen for terrestrial invertebrates. Eight COPCs (i.e., aluminum, barium, chromium, copper, manganese, mercury, zinc, and total HPAHs) were identified based on soil data from surface (upper 6 inches) and intermediate (6 to 12 inches[1]) depths because maximum soil concentrations were greater than the lowest soil screening thresholds. These COPCs are evaluated further in the terrestrial invertebrate risk assessment (Section 5.1.2).

Table 2-21. Terrestrial Invertebrate COPC Screen Results for Soil

Wetland Soil COI	Unit (dw)	Maximum Concentration	Screening Threshold	COPC?
Metals				
Aluminum	mg/kg	12,100	600	**yes**
Antimony	mg/kg	8.4	78	no
Arsenic	mg/kg	53.1	60	no
Barium	mg/kg	481	330	**yes**
Beryllium	mg/kg	0.544	40	no
Cadmium	mg/kg	4	20	no
Chromium	mg/kg	149	0.4	**yes**
Cobalt	mg/kg	34.3	1,000	no
Copper	mg/kg	1,240	50	**yes**
Lead	mg/kg	320	500	no
Manganese	mg/kg	1,090	100	**yes**
Mercury	mg/kg	0.4	0.1	**yes**
Nickel	mg/kg	48	200	no
Selenium	mg/kg	1.1	4.1	no
Silver	mg/kg	1.5	50	no
Zinc	mg/kg	748	120	**yes**
PAHs				
Fluorene	µg/kg	417	30,000	no
Total HPAHs	µg/kg	57,000	18,000	**yes**
Total LPAHs	µg/kg	12,200	29,000	no
Other SVOCs				
1,4-Dichlorobenzene	µg/kg	19	20,000	no
Hexachlorobenzene	µg/kg	42	1,000,000	no
Pentachlorophenol	µg/kg	80	4,000	no
Phenol	µg/kg	498	30,000	no

COI – chemical of interest
COPC – chemical of potential concern
dw – dry weight
HPAH – high-molecular-weight polycyclic aromatic hydrocarbon
LPAH – low-molecular-weight polycyclic aromatic hydrocarbon
PAH – polycyclic aromatic hydrocarbon
SVOC – semivolatile organic compound
Bold identifies COPCs.

[1] Berm soil samples included soil collected from the depth interval of 6 to 24 inches.

2.6.3 Fish

This section presents the COPC screen for the fish ROCs (pumpkinseed and brown bullhead), which is summarized in Figure 2-6.

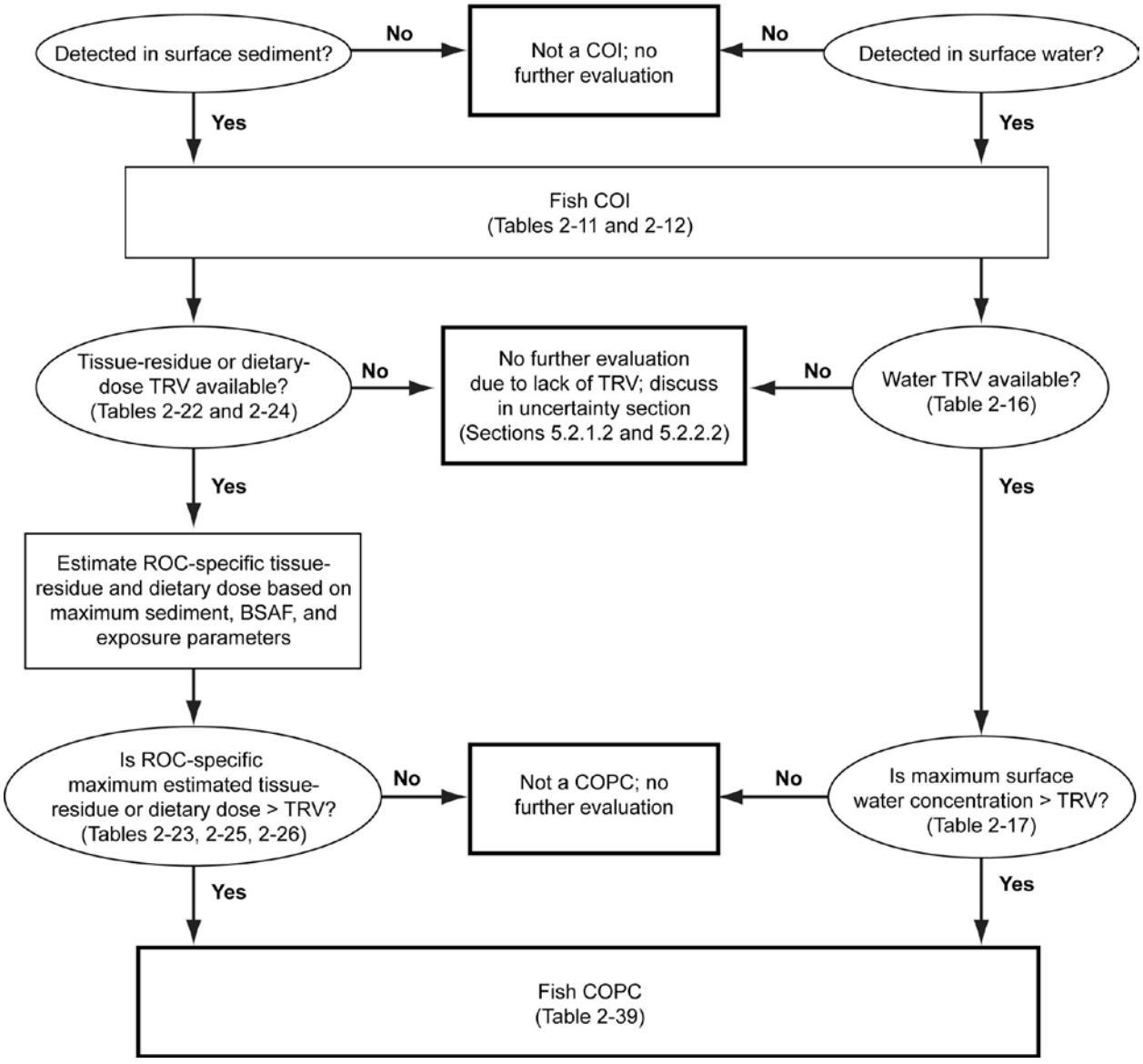

Figure 2-6. COPC Screening Process for Fish ROCs

2.6.3.1 COIs for Fish

The first step in the COPC screen for fish was the identification of COIs. COIs were defined as any analyte detected in surface sediment or surface water. The COIs are presented in Tables 2-11 and 2-12.

COPCs were then developed from the COI lists. For fish, three screens were conducted: 1) a fish tissue-residue screen of all surface sediment COIs, excepted surface sediment COIs evaluated using a dietary approach, 2) a surface water screen of all surface water COIs, and 3) a dietary screen of all surface sediment COIs that are metabolized or regulated by fish (all metals except mercury and all PAHs).These screens are discussed below.

2.6.3.2 Tissue-Residue COPC Screen for Fish

Tissue-residue COPCs for fish ROCs were identified by comparing maximum estimated COI concentrations in fish tissue to tissue-residue no-observed-adverse-effects level (NOAEL)[2] toxicity reference values (TRVs). COIs with maximum concentrations greater than the NOAEL TRVs were identified as COPCs for fish for further evaluation in the ERA in Section 5.2.

A comprehensive literature search was conducted to identify appropriate toxicity studies for the development of fish tissue-residue NOAEL TRVs. The following sources were searched to identify acceptable toxicity studies in the literature for tissue-residue COIs identified for fish:

- BIOSIS
- Environmental Residue Effects Database
- EPA's ECOTOX database
- Jarvinen and Ankley (1999)

Original sources of toxicity data were obtained and reviewed to verify effects data summarized in the databases as well as the suitability of the studies. The databases were searched for studies that evaluated effects on survival, growth, and reproduction.

Acceptable toxicological data that met the following criteria were compiled for fish:

- The chemical concentration in whole body tissue was analyzed as part of the study.
- All selected TRVs were based on laboratory toxicological studies (not field studies). Laboratory studies were used because of the uncertainty surrounding results obtained from field studies (e.g., presence of other chemicals or other confounding factors).
- Studies had to have experimental controls, replicates, and a statistical analysis of the results.
- Selected TRVs based on exposure via diet, sediment, or water were preferred.

[2] NOAEL TRVs are concentrations below which no adverse effects have been observed.

- Other exposure routes including intraperitoneal (IP) or egg injection or oral gavage were only used when no other studies were found.

After the literature search was conducted, all acceptable studies for TRV derivation were compiled. Appendix A provides a table of all fish tissue-residue NOAEL and lowest-observed-adverse-effects level (LOAEL)[3] TRVs reviewed from the literature. The NOAEL TRV was selected as the highest no-effect value below the lowest LOAEL TRV based on the same endpoint. If no NOAEL TRV of the same endpoint was available below the selected LOAEL, an uncertainty factor (UF) was used based on guidance from EPA Region 10 (1997).

Selected tissue-residue NOAEL TRVs are presented in Table 2-22. No tissue TRVs were available for the following tissue COIs: acetone, carbon disulfide, methyl ethyl ketone, toluene, or TPHs; these chemicals are noted in the uncertainty analysis.

Table 2-22. Selected Tissue-Residue NOAEL TRVs for the Fish COPC Screen

Tissue-Residue COI	NOAEL TRV (µg/kg ww)	Endpoint	Source
Metals			
Mercury	230	survival	Webber and Haines (2003)
PCBs			
Total PCBs[a]	104	reproduction	Hugla and Thome (1999)
Pesticides			
Total DDTs[b]	1,800	survival	Allison et al. (1964)

[a] Individual PCB Aroclor COIs listed in Table 2-11 (Aroclor 1254 and Aroclor 1260) were evaluated as part of the total PCB sum.

[b] Individual DDT metabolite COIs listed in Table 2-11 (2,4′-DDD, 4,4′-DDD, and 4,4′-DDE) were evaluated as part of the total DDT sum.

COI – chemical of interest
DDT – dichlorodiphenyltrichloroethane
NOAEL – no-observed-adverse-effect level
PCB – polychlorinated biphenyl
TRV – toxicity reference value
ww – wet weight

For comparison to the NOAEL TRVs, COI concentrations in fish tissue were estimated using fish biota-sediment accumulation factors (BSAFs) and assumptions presented in Appendix B. Total PCB and total DDT BSAFs were based on tissue and sediment data that were lipid and organic-carbon (OC)-normalized, respectively. The average lipid concentrations reported by EPA (2008) for pumpkinseed and brown bullhead (3.1% and 2.6%, respectively) were used to estimate total PCB and total DDT tissue concentrations. An average fish moisture content (72%) reported by EPA (1993) was used to estimate wet weight mercury concentrations in fish tissue from the dry-weight-based mercury BSAF.

Table 2-23 presents the results of the fish tissue COPC screen. Total PCBs was identified as a COPC for both pumpkinseed and brown bullhead. Total PCBs are evaluated further in the fish risk assessment using the tissue-residue approach (Section 5.2).

[3] LOAEL TRVs are the lowest concentrations at which an adverse effect occurred. Acute or subchronic LOAELs were divided by a UF of 10; chronic or critical life-stage LOAELs were divided by a UF of 5; and LC50 (i.e., concentration that is lethal to 50% of an exposed population) (or similar) LOAELs were divided by a UF of 50.

Table 2-23. Results of the COPC Screen for Fish Using the Tissue-Residue Approach

Tissue-Residue COI	BSAF		Maximum Sediment Concentration	Estimated Maximum Tissue Concentration			COPC?
	Value	Unit		Unit (ww)	C_{fish}[a]	NOAEL TRV	
Pumpkinseed							
Mercury	0.38	dw/dw	0.2 mg/kg dw	mg/kg	0.021	0.23	no
Total PCBs	6.45	lipid/OC	1.83 mg/kg OC	µg/kg	370	104	**yes**
Total DDTs	3.0	lipid/OC	3.7 mg/kg OC	µg/kg	340	1,800	no
Brown Bullhead							
Mercury	0.38	dw/dw	0.2 mg/kg dw	mg/kg	0.021	0.23	no
Total PCBs	6.45	lipid/OC	1.83 mg/kg OC	µg/kg	310	104	**yes**
Total DDTs	3.0	lipid/OC	3.7 mg/kg OC	µg/kg	290	1,800	no

[a] C_{fish} was estimated using BSAFs and ROC-specific exposure assumptions. When the sediment concentration was dw, the following equation was used: C_{fish} (ww) = (BSAF x Max_{sed}) x (1 – F_M), where F_M = fraction moisture. When the sediment concentration was OC-normalized, the following equation was used: C_{fish} (ww) = (BSAF x Max_{sed}) x F_L, where F_L = fraction lipid. For pumpkinseed, average percent moisture and percent lipids were 72 and 3.1%, respectively. For brown bullhead, average percent moisture and percent lipids were 72 and 2.6%, respectively. See Appendix B for details on how BSAFs and assumptions were selected.

BSAF – biota-sediment accumulation factor
COI – chemical of interest
COPC – chemical of potential concern
DDT – dichlorodiphenyltrichloroethane
dw – dry weight
NOAEL – no-observed-adverse-effect level
OC – organic carbon
PCB – polychlorinated biphenyl
TRV – toxicity reference value
ww – wet weight
Bold text identifies COPCs.

2.6.3.3 Surface Water COPC Screen for Fish

The second COPC screen conducted for fish involved the use of surface water data. Surface water COPCs for fish were identified through a comparison of maximum surface water concentrations to chronic water screening thresholds. Surface water COPCs for fish were identified using the same water screening thresholds (Table 2-16) as used to identify surface water COPCs for aquatic benthic invertebrates. Consequently, the same COPCs identified in surface water for aquatic benthic invertebrates were identified as COPCs in surface water for fish (Table 2-17).These two COPCs (barium and copper) are evaluated further in the fish risk assessment (Section 5.2).

2.6.3.4 Dietary Dose COPC Screen for Fish

The third COPC screen conducted for fish was conducted using a dietary dose approach for chemicals that are metabolized or regulated by fish (i.e., metals [except mercury] and PAHs). To identify dietary COPCs for fish ROCs, maximum detected concentrations in sediment and maximum estimated chemical concentrations in potential prey items for a given ROC (i.e., pumpkinseed and brown bullhead) were used to estimate a maximum dietary dose (see method described in Section 4.1). COI concentrations in fish prey were estimated using BSAFs and assumptions presented in Appendix B. These concentrations were converted to dietary doses using the approach outlined in Section 3.2.2.

Maximum dietary doses were then compared to dietary-dose NOAEL TRVs; COIs with maximum doses that were greater than the NOAEL TRVs were identified as COPCs.

A comprehensive literature search was conducted on published toxicity studies to date to identify appropriate toxicity studies for the development of dietary-dose TRVs. The following sources were searched to identify acceptable toxicity studies in the literature in order to establish dietary-dose TRVs for fish dietary COIs:

- BIOSIS
- Environmental Residue Effects Database
- EPA's ECOTOX database

Original sources of toxicity data were obtained and reviewed to verify effects data summarized in the databases as well as the suitability of the studies. The databases were searched for studies that evaluated effects on survival, growth, and reproduction.

Acceptable toxicological data that met the following criteria were compiled:

- All studies were based on dietary exposure.
- All selected TRVs were based on laboratory toxicological studies (not field studies). Laboratory studies were used because of the uncertainty surrounding results obtained from field studies (e.g., presence of other chemicals or other confounding factors).
- Studies were excluded if they did not have experimental controls, replicates, and a statistical analysis of the results.

Dietary-dose TRVs (in mg/kg bw/day) were calculated based on the information provided in the acceptable studies. Most toxicological studies presented reported concentrations in mg/kg food; thus, it was necessary to calculate a daily dose (mg/kg bw/day) based on ROC body weight, ingestion rate (IR), and the percent moisture of the food. If this information was not provided in the study, default values were used from the following sources:

- **Body weight:** If no body weight data were provided in the study or data provided were not considered representative, body weights for fish were estimated from other literature sources or toxicity studies.
- **Ingestion rate:** If no ingestion rates were provided in the study, they were estimated from other literature sources for the same species. If no other literature sources were available, an ingestion rate of 2% food (dw)/kg bw/day was assumed as a conservative estimate based on the food ingestion rates commonly reported for laboratory toxicity studies.
- **Percent moisture:** A commercial feed or pelleted diet was assumed to approximate a dw concentration, and 80% moisture was assumed when the diet consisted of organism prey (e.g., invertebrate prey).

Once TRVs were calculated for all studies, NOAEL TRVs were established for COIs using the same criteria described in Section 2.6.3.2. Selected fish dietary TRVs are presented in Table 2-24. Appendix A provides tables of all dietary-dose NOAEL and LOAEL TRVs reviewed from the literature. No dietary-dose TRVs

were available for five fish COIs: barium, cobalt, nickel, 2-methylnaphthalene, and dibenzofuran; these chemicals are noted in the uncertainty analysis. Individual PAH COIs (other than benzo[a]pyrene) were evaluated using TRVs for total PAHs and benzo(a)pyrene.

Table 2-24. Selected Dietary-Dose NOAEL TRVs for the Fish COPC Screen

Dietary COI	Test Species	NOAEL (mg/kg bw/day)	Endpoint	Source
Metals				
Arsenic	rainbow trout	0.40	growth	Oladimeji et al. (1984)
Cadmium	rockfish	0.0020[a]	growth	Kim et al. (2004); Kang et al. (2005)
Chromium	grey mullet	9.42	growth	Walsh et al. (1994)
Copper	rockfish	1.0	growth	Kang et al. (2005)
Lead	rainbow trout	134	growth	Goettl et al. (1976)
Silver	rainbow trout	70	growth	Galvez and Wood (1999)
Vanadium	rainbow trout	0.039[a]	growth	Hilton and Bettger (1988)
Zinc	rainbow trout	19	growth	Takeda and Shimma (1977)
PAHs				
Benzo(a)pyrene	English sole	0.66	growth	Rice et al. (2000)
Total PAHs[b]	Chinook salmon	6.1[c]	growth	Meador et al. (2006)

[a] NOAEL was estimated using a UF of 5 (chronic LOAEL to NOAEL).

[b] Individual PAH COIs listed in Table 2-11 (acenaphthylene, acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, total benzofluoranthenes [benzo(b)fluoranthene and benzo(k)fluoranthene], benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, indeno(1,2,3,-c,d)pyrene, fluoranthene, fluorene, naphthalene, phenanthrene, and pyrene) were evaluated as part of the total PAH sum.

[c] Mixture contained the following 21 PAHs included in the Meador et al. (2006) diet: naphthalene, 2-methylnaphthalene, dimethylnaphthalene, dibenzothiophene, acenaphthene, fluorene, 1,8-dimethyl(9H)fluorene, phenanthrene, 9-ethylphenanthrene, 9-ethyl-10-methylphenanthrene, 1-methyl-7-isopropylphenanthrene, anthracene, fluoranthene, pyrene, methyl pyrene, benzo(a)anthracene, chrysene, benz(a)pyrene, benzo(k)fluoranthene, benzo(g,h,i)perylene, and dibenzanthracene.

bw – body weight
COI – chemical of interest
COPC – chemical of potential concern
dw – dry weight
NOAEL – no-observed-adverse-effect level
PAH – polycyclic aromatic hydrocarbon
UF – uncertainty factor

Tables 2-25 and 2-26 present the results of the dietary COPC screen for fish ROCs. Three COPCs (i.e., cadmium, copper, and vanadium) were identified for both pumpkinseed and brown bullhead. These COPCs are evaluated further in the fish risk assessment (Section 5.2).

Table 2-25. Results of the Pumpkinseed Dietary COPC Screen

Dietary COI	Sediment Concentration		Aquatic Invertebrate BSAF		Prey Tissue Concentration		Estimated Maximum Dose			COPC?
	C_{sed} [a]	Unit	BSAF Value	Unit	$C_{aquat\ invert}$ [b]	Unit	$Dose_{diet}$ [c]	NOAEL TRV	Unit	
Metals										
Arsenic	7	mg/kg dw	0.24	tiss dw/sed dw	0.35	mg/kg ww	0.04	0.4	mg/kg bw/day	no
Cadmium	2	mg/kg dw	3.438	tiss dw/sed dw	1.4	mg/kg ww	0.15	0.002	mg/kg bw/day	**yes**
Chromium	34	mg/kg dw	0.206	tiss dw/sed dw	1.5	mg/kg ww	0.17	9.42	mg/kg bw/day	no
Copper	72	mg/kg dw	2.14	tiss dw/sed dw	32	mg/kg ww	**3.5**	1	mg/kg bw/day	**yes**
Lead	56	mg/kg dw	0.331	tiss dw/sed dw	3.9	mg/kg ww	0.43	134	mg/kg bw/day	no
Vanadium	74	mg/kg dw	1	tiss dw/sed dw	16	mg/kg ww	**1.7**	0.039	mg/kg bw/day	**yes**
Zinc	229	mg/kg dw	3.473	tiss dw/sed dw	170	mg/kg ww	**18**	19	mg/kg bw/day	no
PAHs										
Benzo(a)pyrene	1.3	mg/kg OC	0.383	tiss lipid/sed OC	6.0	µg/kg ww	0.65	660	µg/kg bw/day	no
Total PAHs	19.8	mg/kg OC	0.923	tiss lipid/sed OC	220	µg/kg ww	24	6100	µg/kg bw/day	no

[a] C_{sed} is represented by maximum sediment concentration.

[b] $C_{aquatic\ invert}$ was estimated from C_{sed} (either as a dw concentration or an OC-normalized concentration) and aquatic benthic invertebrate BSAF. When the sediment concentration was dw, the following equation was used: $C_{aquatic\ invert}$ (ww) = (BSAF x Max_{sed}) x (1 – F_M), where F_M = fraction moisture. When the sediment concentration was OC-normalized, the following equation was used: $C_{aquatic\ invert}$ (ww) = (BSAF x Max_{sed}) x F_L, where F_L = fraction lipid. $C_{aquatic\ invert}$ was converted to ww assuming a moisture content of 79% or a lipid content of 1.2%. See Appendix B for details on selected BSAFs and assumptions used to estimate prey tissue concentrations.

[c] $Dose_{diet}$ was calculated using Equation 3-1, exposure parameters presented in Table 3-5, and assumption that diet is comprised of 100% aquatic invertebrates.

BSAF – biota-sediment accumulation factor
bw – body weight
COI – chemical of interest
COPC – chemical of potential concern
dw – dry weight
NOAEL – no-observed-adverse-effect level
OC – organic carbon
PAH – polycyclic aromatic hydrocarbon
TRV – toxicity reference value
ww – wet weight
BOLD identifies COPCs.

Table 2-26. Results of the Brown Bullhead Dietary COPC Screen

Dietary COI	Sediment Concentration		BSAF			Prey Tissue Concentration			Estimated Maximum Dose			COPC?
	C_{sed} [a]	Unit	Fish BSAF	Aquatic Invert BSAF	Unit	C_{fish} [b]	$C_{aquatic\ invert}$ [c]	Unit	$Dose_{diet}$ [d]	NOAEL TRV	Unit	
Metals												
Arsenic	7	mg/kg dw	0.12	0.24	tiss dw/sed dw	0.24	0.35	mg/kg ww	0.032	0.4	mg/kg bw/day	no
Cadmium	2	mg/kg dw	0.785	3.438	tiss dw/sed dw	0.44	1.4	mg/kg ww	**0.089**	0.002	mg/kg bw/day	**yes**
Chromium	34	mg/kg dw	0.043	0.206	tiss dw/sed dw	0.41	1.5	mg/kg ww	0.14	9.42	mg/kg bw/day	no
Copper	72	mg/kg dw	1	2.14	tiss dw/sed dw	20	32	mg/kg ww	**2.1**	1	mg/kg bw/day	**yes**
Lead	56	mg/kg dw	0.18	0.331	tiss dw/sed dw	2.8	3.9	mg/kg ww	0.33	134	mg/kg bw/day	no
Vanadium	74	mg/kg dw	1	1	tiss dw/sed dw	21	16	mg/kg ww	**1.2**	0.039	mg/kg bw/day	**yes**
Zinc	229	mg/kg dw	1.83	3.473	tiss dw/sed dw	120	170	mg/kg ww	11	19	mg/kg bw/day	no
PAHs												
Benzo(a)pyrene	1.3	mg/kg OC	0.0021	0.383	tiss lipid/sed OC	0.1	6	µg/kg ww	0.36	660	µg/kg bw/day	no
Total PAHs	19.8	mg/kg OC	0.0299	0.923	tiss lipid/sed OC	22	220	µg/kg ww	13	6,100	µg/kg bw/day	no

[a] C_{sed} is represented by maximum sediment concentration.

[b] C_{fish} was estimated from C_{sed} (as a dw concentration or an OC-normalized concentration) and a fish BSAF. When the sediment concentration was dw, the following equation was used: C_{fish} (ww) = (BSAF x Max_{sed}) x (1 – F_M), where F_M = fraction moisture. When the sediment concentration was OC-normalized, the following equation was used: C_{fish} (ww) = (BSAF x Max_{sed}) x F_L, where F_L = fraction lipid. C_{fish} was converted to ww assuming a moisture content of 72% or a lipid content of 3.7%. See Appendix B for details on selected BSAFs and assumptions used to estimate prey tissue concentrations.

[c] $C_{aquatic\ invert}$ was estimated from C_{sed} (either as a dw concentration or an OC-normalized concentration) and aquatic benthic invertebrate BSAF. When the sediment concentration was dw, the following equation was used: $C_{aquatic\ invert}$ (ww) = (BSAF x Max_{sed}) x (1 – F_M), where F_M = fraction moisture. When the sediment concentration was OC-normalized, the following equation was used: $C_{aquatic\ invert}$ (ww) = (BSAF x Max_{sed}) x F_L, where F_L = fraction lipid. $C_{aquatic\ invert}$ was converted to ww assuming a moisture content of 79% or a lipid content of 1.2%. See Appendix B for details on selected BSAFs and assumptions used to estimate prey tissue concentrations.

[d] $Dose_{diet}$ was calculated using Equation 3-1, exposure parameters presented in Table 3-5, and assumption that diet is composed of 10% fish and 90% aquatic invertebrates.

BSAF – biota-sediment accumulation factor
bw – body weight
COI – chemical of interest
COPC – chemical of potential concern
dw – dry weight
NOAEL – no-observed-adverse-effect level
OC – organic carbon
PAH – polycyclic aromatic hydrocarbon
TRV – toxicity reference value
ww – wet weight

BOLD identifies COPCs

2.6.4 Aquatic Birds

This section presents the COPC screen for the two aquatic bird ROCs (ruddy duck and great blue heron), which is summarized in Figure 2-7.

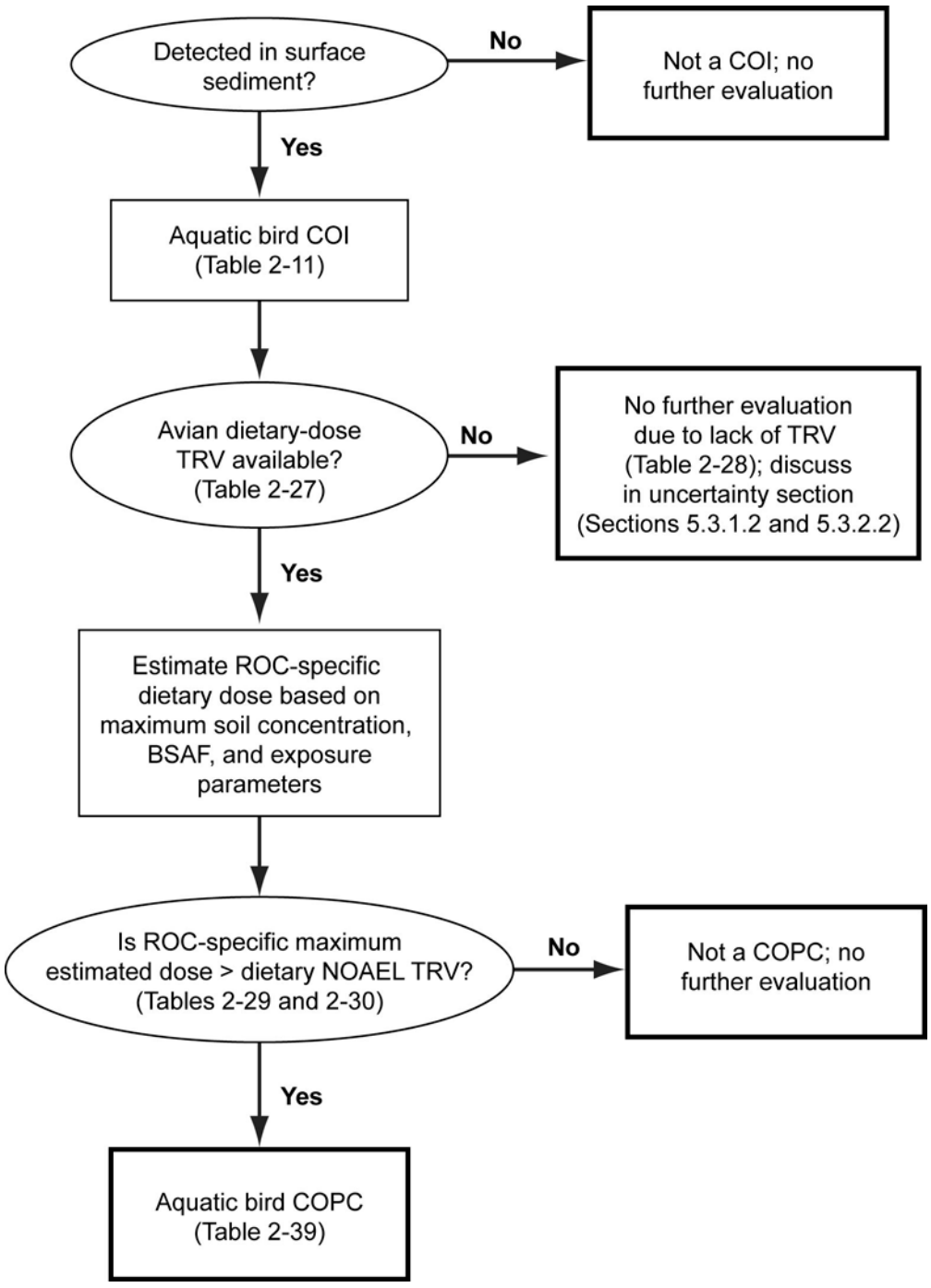

Figure 2-7. COPC Screening Process for Aquatic Bird ROCs

2.6.4.1 COIs for Aquatic Birds

The first step in the COPC screen for aquatic birds was the identification of COIs. COIs were defined as any analyte detected in surface sediment (see Table 2-11).

2.6.4.2 COPC Screen for Aquatic Birds

In the next step to identify COPCs for each of the aquatic bird ROCs, maximum detected concentrations of COIs in sediment and maximum estimated COI concentrations in potential prey items for each ROC were used to estimate a maximum dietary dose (see method described in Section 4.1). COI concentrations in prey were estimated using BSAFs and assumptions presented in Appendix B. These concentrations were converted to dietary doses using the approach outlined in Section 3.2.2. Maximum dietary doses were then compared to dietary-dose NOAEL TRVs; COIs with maximum doses that were greater than the NOAEL TRVs were identified as COPCs.

A comprehensive literature search was conducted on published toxicity studies to date to identify appropriate toxicity studies for the development of dietary-dose TRVs. The following sources were searched to identify acceptable toxicity studies in the literature to establish dietary-dose TRVs for aquatic birds:

- BIOSIS
- EPA's ECOTOX database
- National Library of Medicine's TOXNET database
- US Geological Survey's Contaminant Hazard Review series
- ORNL's database
- EPA's Integrated Risk Information System (IRIS) database
- Agency for Toxic Substances and Disease Registry (ATSDR)

Original sources of toxicity data were obtained and reviewed to verify effects data summarized in the databases as well as the suitability of the studies. The databases were searched for studies that evaluated effects on survival, growth, and reproduction.

Acceptable toxicological data that met the following criteria were compiled:

- Studies conducted based on dietary dose were preferred. As with tissue-residue TRVs, other exposure routes, including IP or egg injection or oral gavage, were used when no other studies were found. Drinking water studies were not used because of differences in the bioavailability of chemicals in water. Non-relevant exposure pathways (e.g., inhalation or absorption) were also not used.
- All selected TRVs were based on laboratory toxicological studies (not field studies). Laboratory studies were used because of the uncertainty surrounding results obtained from field studies (e.g., presence of other chemicals or other confounding factors).
- Studies were excluded if they did not have experimental controls, replicates, and a statistical analysis of the results.

- Egg production studies using chicken or quail, such as Edens and Garlich (1983) and Edens et al. (1976), are highly uncertain because these species have been bred based on high egg-laying rates. These studies were not used.
- Toxicity results based on tests with chemical species considered unlikely to occur at the Study Area (e.g., the fungicide methylmercury dicyandiamide for determining a mercury TRV) were not considered.

Dietary-dose TRVs (in mg/kg bw/day) were calculated based on the information provided in the studies. Most toxicological studies presented reported concentrations in mg/kg food; thus it was necessary to calculate a daily dose (mg/kg bw/day) based on ROC body weight, IR, and the percent moisture of the food. If this information was not provided in the study, default values were used from the following sources:

- **Body weight:** Body weights were selected from EPA's *Wildlife Exposure Factors Handbook* (1993).
- **Ingestion rate:** Allometric equations were used for birds (Nagy 2001), and National Research Council (NRC) data were used for chicks (NRC 1994, 1984).
- **Percent moisture:** Food concentrations were generally reported on a wet-weight basis. However, when concentrations were reported on a dry-weight basis and no percent moisture was provided in the study, a published value from NRC was used based on the diet of the test species (NRC 1994).

Once TRVs had been calculated for all studies, NOAEL TRVs were established for COIs using the same criteria described in Section 2.6.3.2. Selected bird dietary TRVs are presented in Table 2-27. Appendix A provides tables of all dietary-dose NOAEL and LOAEL TRVs reviewed from the literature. The COIs for which no aquatic bird dietary-dose TRV could be developed are presented in Table 2-28; these chemicals will be noted in the uncertainty analysis. Individual PAH COIs (other than benzo[a]pyrene) were evaluated using TRVs for total PAHs and benzo(a)pyrene. Individual DDT metabolite and PCB Aroclor COIs were evaluated using TRVs for total DDTs and total PCBs, respectively.

Table 2-27. Selected Dietary-Dose NOAEL TRVs for the Aquatic Bird COPC Screen

Surface Sediment COI	Test Species	NOAEL (mg/kg bw/day)	Endpoint	Source
Metals				
Arsenic	mallard	10	reproduction	Stanley et al. (1994)
Cadmium	mallard	1.5	growth	Cain et al. (1983)
Chromium	black duck	1.0	reproduction	Haseltine et al. (unpublished), as cited in Sample et al. (1996)
Cobalt	chicken	2.31[a]	growth	Diaz et al. (1994)

Table 2-27. Selected Dietary-Dose NOAEL TRVs for the Aquatic Bird COPC Screen

Surface Sediment COI	Test Species	NOAEL (mg/kg bw/day)	Endpoint	Source
Copper	chicken	21	growth	Poupoulis and Jensen (1976)
Lead	American kestrel	5.82	reproduction	Pattee (1984)
Mercury	great egret	0.018[b]	growth	Spalding et al. (2000)
Nickel	mallard	77	growth	Cain and Pafford (1981)
Vanadium	chicken	1.2	growth	Ousterhout and Berg (1981)
Zinc	chicken	82	growth	Roberson and Schaible (1960)
PAHs				
Benzo(a)pyrene	pigeon	0.28[b]	reproduction	Hough et al. (1993)
Total PAHs[c]	mallard	8.0	growth	Patton and Dieter (1980)
PCBs				
Total PCBs[d]	screech owl	0.49	reproduction	McLane and Hughes (1980)
Pesticides				
Total DDTs[e]	barn owl	0.064[f]	reproduction	Mendenhall et al. (1983)
VOCs				
Acetone	four species	6,647	survival	Hill et al. (1975)

[a] NOAEL was estimated from an acute or subchronic LOAEL using a UF of 10.

[b] NOAEL was estimated from a chronic LOAEL using a UF of 5.

[c] Individual PAH COIs listed in Table 2-11 (acenaphthylene, acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, total benzofluoranthenes [benzo(b)fluoranthene and benzo(k)fluoranthene], benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, indeno(1,2,3,-c,d)pyrene, fluoranthene, fluorene, naphthalene, phenanthrene, and pyrene) were evaluated as part of the total PAH sum.

[d] Individual PCB Aroclor COIs listed in Table 2-11 (Aroclor 1254 and Aroclor 1260) were evaluated as part of the total PCB sum.

[e] Individual DDT metabolite COIs listed in Table 2-11 (2,4′-DDD, 4,4′-DDD, and 4,4′-DDE) were evaluated as part of the total DDT sum.

bw – body weight
COI – chemical of interest
COPC – chemical of potential concern
DDT – dichlorodiphenyltrichloroethane
NOAEL – no-observed-adverse-effect level
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
TRV – toxicity reference value
UF – uncertainty factor
VOC – volatile organic compound

Table 2-28. COIs without Aquatic Bird NOAEL TRVs

Surface Sediment COI	
Metals	
Barium	
PAHs	
2-Methylnapthalene	Dibenzofuran
VOCs	
Carbon disulfide	Toluene
Methyl ethyl ketone	
TPH	
TPH-gasoline range	TPH-motor oil range
TPH-diesel range	Total petroleum hydrocarbons

COI – chemical of interest
NOAEL – no-observed-adverse-effect level
TPH – total petroleum hydrocarbons
TRV – toxicity reference value
VOC – volatile organic compound

Tables 2-29 and 2-30 present the results of the dietary COPC screen for both aquatic bird ROCs. Three COPCs (i.e., mercury, vanadium, and total DDTs) were identified for ruddy duck and two COPCs (i.e., vanadium and total DDTs) were identified for great blue heron. These COPCs are evaluated further in the wildlife risk assessment for each of these ROCs (Section 5.3)

Table 2-29. Results of the Ruddy Duck Dietary COPC Screen

Surface Sediment COI	Sediment Concentration		BSAF		Prey Tissue Concentration		Estimated Maximum Dose			COPC?
	C_{sed} [a]	Unit	Aquatic Invert BSAF	Unit	$C_{aquat\ invert}$ [b]	Unit	$Dose_{diet}$ [c]	NOAEL TRV	Unit	
Metals										
Arsenic	7	mg/kg dw	0.24	tiss dw/sed dw	0.35	mg/kg ww	0.17	10	mg/kg bw/day	no
Cadmium	2	mg/kg dw	3.438	tiss dw/sed dw	1.4	mg/kg ww	0.51	1.5	mg/kg bw/day	no
Chromium	34	mg/kg dw	0.206	tiss dw/sed dw	1.5	mg/kg ww	0.76	1	mg/kg bw/day	no
Cobalt	15	mg/kg dw	1	tiss dw/sed dw	3.2	mg/kg ww	1.2	2.31	mg/kg bw/day	no
Copper	72	mg/kg dw	2.14	tiss dw/sed dw	32	mg/kg ww	12	21	mg/kg bw/day	no
Lead	56	mg/kg dw	0.331	tiss dw/sed dw	3.9	mg/kg ww	1.7	5.82	mg/kg bw/day	no
Mercury	0.2	mg/kg dw	1.204	tiss dw/sed dw	0.051	mg/kg ww	**0.019**	0.018	mg/kg bw/day	**yes**
Nickel	31	mg/kg dw	1.313	tiss dw/sed dw	8.5	mg/kg ww	3.1	77	mg/kg bw/day	no
Vanadium	74	mg/kg dw	1	tiss dw/sed dw	16	mg/kg ww	**6.0**	1.2	mg/kg bw/day	**yes**
Zinc	229	mg/kg dw	3.473	tiss dw/sed dw	170	mg/kg ww	60	82	mg/kg bw/day	no
PAHs										
Benzo(a)pyrene	1.3	mg/kg OC	0.383	tiss lipid/sed OC	6.0	µg/kg ww	2.1	280	µg/kg bw/day	no
Total PAHs	19.8	mg/kg OC	0.923	tiss lipid/sed OC	220	µg/kg ww	76	8,000	µg/kg bw/day	no
PCBs										
Total PCBs	1.83	mg/kg OC	2.57	tiss lipid/sed OC	56	µg/kg ww	19	490	µg/kg bw/day	no
Pesticides										
Total DDTs	3.7	mg/kg OC	4.52	tiss lipid/sed OC	200	µg/kg ww	**69**	64	µg/kg bw/day	**yes**
VOCs										
Acetone	14	mg/kg OC	1	tiss lipid/sed OC	170	µg/kg ww	59	6,647,000	µg/kg bw/day	no

[a] C_{sed} is represented by maximum sediment concentration.

[b] $C_{aquatic\ invert}$ was estimated from C_{sed} (either as a dw concentration or an OC-normalized concentration) and aquatic benthic invertebrate BSAF. When the sediment concentration was dw, the following equation was used:, $C_{aquatic\ invert}$ (ww) = (BSAF x Max_{sed}) x (1 – F_M), where F_M = fraction moisture. When the sediment concentration was OC-normalized, the following equation was used: $C_{aquatic\ invert}$ (ww) = (BSAF x Max_{sed}) x F_L, where F_L = fraction lipid. $C_{aquatic\ invert}$ was converted to ww assuming a moisture content of 79% or a lipid content of 1.2%. See Appendix B for details on selected BSAFs and assumptions used to estimate prey tissue concentrations.

[c] $Dose_{diet}$ was calculated using Equation 3-1, exposure parameters presented in Table 3-9, and assumption that diet is composed of 100% aquatic invertebrates.

BSAF – biota-sediment accumulation factor
bw – body weight
dw – dry weight
NOAEL – no-observed-adverse-effect level
PCB – polychlorinated biphenyl
TRV – toxicity reference value

COI – chemical of interest
COPC – chemical of potential concern
DDT – dichlorodiphenyltrichloroethane
BOLD identifies COPCs.

OC – organic carbon
PAH – polycyclic aromatic hydrocarbon

VOC – volatile organic compound
ww – wet weight

Table 2-30. Results of the Great Blue Heron Dietary COPC Screen

Surface Sediment COI	Sediment Concentration		BSAF			Prey Tissue Concentration			Estimated Maximum Dose			COPC?
	C_{sed} [a]	Unit	Fish BSAF	Aquatic Invert BSAF	Unit	C_{fish} [b]	$C_{aquat\ invert}$ [c]	Unit	$Dose_{diet}$ [d]	NOAEL TRV	Unit	
Metals												
Arsenic	7	mg/kg dw	0.12	0.24	tiss dw/sed dw	0.24	0.35	mg/kg ww	0.05	10	mg/kg bw/day	no
Cadmium	2	mg/kg dw	0.785	3.438	tiss dw/sed dw	0.44	1.4	mg/kg ww	0.09	1.5	mg/kg bw/day	no
Chromium	34	mg/kg dw	0.043	0.206	tiss dw/sed dw	0.41	1.5	mg/kg ww	0.12	1	mg/kg bw/day	no
Cobalt	15	mg/kg dw	1	1	tiss dw/sed dw	4.2	3.2	mg/kg ww	0.76	2.31	mg/kg bw/day	no
Copper	72	mg/kg dw	1	2.14	tiss dw/sed dw	20	32	mg/kg ww	3.8	21	mg/kg bw/day	no
Lead	56	mg/kg dw	0.18	0.331	tiss dw/sed dw	2.8	3.9	mg/kg ww	0.57	5.82	mg/kg bw/day	no
Mercury	0.2	mg/kg dw	0.38	1.204	tiss dw/sed dw	0.021	0.051	mg/kg ww	0.0043	0.018	mg/kg bw/day	no
Nickel	31	mg/kg dw	1	1.313	tiss dw/sed dw	8.7	8.5	mg/kg ww	1.6	77	mg/kg bw/day	no
Vanadium	74	mg/kg dw	1	1	tiss dw/sed dw	21	16	mg/kg ww	**3.8**	1.2	mg/kg bw/day	**yes**
Zinc	229	mg/kg dw	1.83	3.473	tiss dw/sed dw	118	167	mg/kg ww	22	82	mg/kg bw/day	no
PAHs												
Benzo(a)pyrene	1.3	mg/kg OC	0.0021	0.383	tiss lipid/ sed OC	0.10	6.0	µg/kg ww	0.072	280	µg/kg bw/day	no
Total PAHs	19.8	mg/kg OC	0.0299	0.923	tiss lipid/ sed OC	22	220	µg/kg ww	5.8	8,000	µg/kg bw/day	no
PCBs												
Total PCBs	1.83	mg/kg OC	6.45	2.57	tiss lipid/ sed OC	440	56	µg/kg ww	76	490	µg/kg bw/day	no
Pesticides												
Total DDTs	3.7	mg/kg OC	3.0	4.52	tiss lipid/ sed OC	410	200	µg/kg ww	72	64	µg/kg bw/day	**yes**
VOCs												
Acetone	14	mg/kg OC	1	1	tiss lipid/ sed OC	520	170	µg/kg ww	90	6,647,000	µg/kg bw/day	no

[a] C_{sed} is represented by maximum sediment concentration.

[b] C_{fish} was estimated from C_{sed} (either as a dw concentration or an OC-normalized concentration) and fish BSAF. When the sediment concentration was dw, the following equation was used: C_{fish} (ww) = (BSAF x Max_{sed}) x (1 – F_M), where F_M = fraction moisture. When the sediment concentration was OC-normalized, the following equation was used: Max_{sed} (OC), C_{fish} (ww) = (BSAF x Max_{sed}) x F_L, where F_L = fraction lipid. C_{fish} was converted to ww assuming a

moisture content of 72% or a lipid content of 3.7%. See Appendix B for details on selected BSAFs and assumptions used to estimate prey tissue concentrations.

[c] $C_{aquatic\ invert}$ was estimated from C_{sed} (either as a dw concentration or an OC-normalized concentration) and aquatic benthic invertebrate BSAF. When the sediment concentration was dw, the following equation was used: $C_{aquatic\ invert}$ (ww) = (BSAF x Max_{sed}) x (1 – F_M), where F_M = fraction moisture When the sediment concentration was OC-normalized, the following equation was used: $C_{aquatic\ invert}$ (ww) = (BSAF x Max_{sed}) x F_L, where F_L = fraction lipid. $C_{aquatic\ invert}$ was converted to ww assuming a moisture content of 79% or a lipid content of 1.2%. See Appendix B for details on selected BSAFs and assumptions used to estimate prey tissue concentrations.

[d] $Dose_{diet}$ was calculated using Equation 3-1, exposure parameters presented in Table 3-9, and assumption that diet is composed of 95% fish and 5% aquatic invertebrates.

BSAF – biota-sediment accumulation factor
bw – body weight
COI – chemical of interest
COPC – chemical of potential concern
DDT – dichlorodiphenyltrichloroethane
dw – dry weight
NOAEL –no-observed-adverse-effect level
OC – organic carbon
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
TRV – toxicity reference value
VOC – volatile organic compound
ww – wet weight
BOLD identifies COPCs.

2.6.5 Terrestrial Birds

This section presents the COPC screen, which is summarized in Figure 2-8, for the terrestrial bird ROC (the red-tailed hawk).

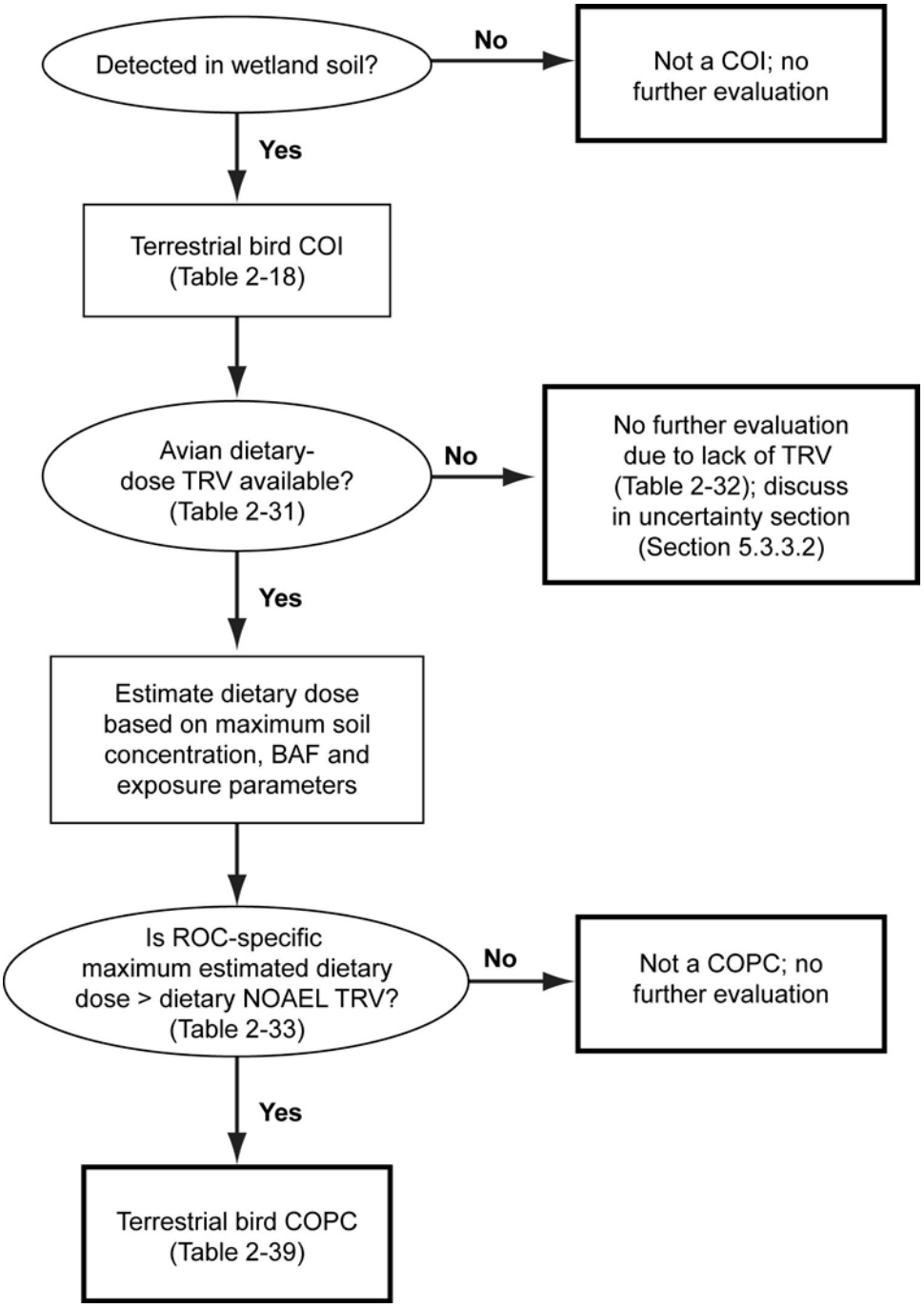

Figure 2-8. COPC Screening Process for Terrestrial Bird ROCs

2.6.5.1 COIs for Terrestrial Birds

The first step in the COPC screen for the terrestrial bird ROC was the identification of COIs. COIs were defined as any analyte detected in wetland soil (see Table 2-18).

2.6.5.2 COPC Screen for Terrestrial Birds

In the next step to identify COPCs for red-tailed hawk, maximum detected COI concentrations in soil and maximum estimated COI concentrations in potential prey items were used to estimate a maximum dietary doses for each COI (see method described in Section 4.1). COI concentrations in prey were estimated using biota accumulation factors (BAFs) and assumptions presented in Appendix B. These concentrations were converted to dietary doses using the approach outlined in Section 3.2.2. Maximum dietary doses were then compared to dietary-dose NOAEL TRVs; COIs with maximum doses that were greater than the NOAEL TRVs were identified as COPCs for red-tailed hawk.

NOAEL TRVs, presented in Table 2-31, were identified using the process presented in Section 2.6.3.2. The COIs without available terrestrial bird NOAEL TRVs are presented in Table 2-32; these COIs will be noted in the uncertainty analysis. Individual PAH COIs (other than benzo[a]pyrene) were evaluated using TRVs for total PAHs and benzo(a)pyrene. Individual DDT metabolite and PCB Aroclor COIs were evaluated using TRVs for total DDTs and total PCBs, respectively.

Table 2-31. Selected Dietary-Dose NOAEL TRVs for the Terrestrial Bird COPC Screen

Wetland Soil COI	Test Species	NOAEL (mg/kg bw/day)	Endpoint	Source
Metals				
Aluminum	Japanese quail	157	reproduction, growth	Carriere et al. (1986)
Arsenic	mallard	10	reproduction	Stanley et al. (1994)
Cadmium	mallard	1.5	growth	Cain et al. (1983)
Chromium	black duck	1.0	reproduction	Haseltine et al. (unpublished), as cited in Sample et al. (1996)
Cobalt	chicken	2.31[a]	growth	Diaz et al. (1994)
Copper	chicken	21	growth	Poupoulis and Jensen (1976)
Lead	American kestrel	5.82	reproduction	Pattee (1984)
Mercury	great egret	0.018[b]	growth	Spalding et al. (2000)
Nickel	mallard	77	growth	Cain and Pafford (1981)
Selenium	mallard	0.50	reproduction	Heinz et al. (1987)
Vanadium	chicken	1.2	growth	Ousterhout and Berg (1981)

Table 2-31. Selected Dietary-Dose NOAEL TRVs for the Terrestrial Bird COPC Screen

Wetland Soil COI	Test Species	NOAEL (mg/kg bw/day)	Endpoint	Source
Zinc	chicken	82	growth	Roberson and Schaible (1960)
PAHs				
Benzo(a)pyrene	pigeon	0.28[b]	reproduction	Hough et al. (1993)
Total PAHs[c]	mallard	8.0	growth	Patton and Dieter (1980)
Phthalates				
BEHP	chicken	65.8[d]	reproduction	Ishida et al. (1982)
Butyl benzyl phthalate	chicken	65.8[d]	reproduction	BEHP TRVs
Di-n-butyl phthalate	chicken	65.8[d]	reproduction	BEHP TRVs
Other SVOCs				
Hexachloro-benzene	Japanese quail	1.1	reproduction	Vos et al. (1971)
Pentachlorophenol	chicken	22	growth	Prescott et al. (1982)
PCBs				
Total PCBs[e]	screech owl	0.49	reproduction	McLane and Hughes (1980)
Pesticides				
Total DDTs[f]	barn owl	0.064[g]	reproduction	Mendenhall et al. (1983)
delta-BHC[h]	mallard	1.6[h]	reproduction	Chakravarty and Lahiri (1986); Chakravarty et al. (1986)[i]
Methoxychlor	zebra finch	34.6	reproduction	Gee et al. (2004)[i]
			survival	Millam et al. (2002)[i]
VOCs				
Acetone	four species	6,647	survival	Hill et al. (1975)

[a] NOAEL was estimated from an acute or subchronic LOAEL using a UF of 10.

[b] NOAEL was estimated from a chronic LOAEL using a UF of 5.

[c] Individual PAH COIs listed in Table 2-18 (acenaphthylene, acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, total benzofluoranthenes [benzo(b)fluoranthene and benzo(k)fluoranthene], benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, indeno(1,2,3,-c,d)pyrene, fluoranthene, fluorene, naphthalene, phenanthrene, and pyrene) were evaluated as part of the total PAH sum.

[d] There was a NOAEL of 1.45 mg/kg bw/day from a study that reported no effect on eggshell thinning, but this is an unbounded NOAEL at a substantially lower concentration than that in the study with observed effects. Therefore, the NOAEL was estimated from the reproductive LOAEL using a UF of 5.

[e] Individual PCB Aroclor COIs listed in Table 2-18 (Aroclor 1248, Aroclor 1254, and Aroclor 1260) were evaluated as part of the total PCB sum.

[f] Individual DDT metabolite COIs listed in Table 2-18 (2,4′-DDD, 2,4′-DDE, 2,4′-DDT, 4,4′-DDD, 4,4′-DDE, and 4,4′-DDT) were evaluated as part of the total DDT sum.

[g] There was a NOAEL of 0.19 mg/kg bw/day from a study that reported no effect on eggshell thinning from exposure of barn owls to DDT (Mendenhall et al. 1983). However, as discussed in Section 6.3.1.2, there is evidence indicating that p,p'-DDE rather than DDT was the likely

cause of eggshell thinning (Lundholm 1997). Therefore, the NOAEL was estimated from the DDE LOAEL for eggshell thinning using a factor of 5.

[h] TRVs for delta-BHC were based on TRVs reported for gamma-BHC (lindane).

[i] Both studies had the same LOAEL and NOAEL.

BEHP – bis(2-ethylhexyl) phthalate
BHC – hexachlorocyclohexane
bw – body weight
COI – chemical of interest
COPC – chemical of potential concern
DDT – dichlorodiphenyltrichloroethane
NOAEL – no-observed-adverse-effect level
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
SVOC – semivolatile organic compound
TRV – toxicity reference value
UF – uncertainty factor
VOC – volatile organic compound

Table 2-32. COIs without Terrestrial Bird NOAEL TRVs

Surface Sediment COI	
Metals	
Antimony	Manganese
Barium	Silver
Beryllium	
PAHs	
2-Methylnaphthalene	Dibenzofuran
Other SVOCs	
1,4-Dichlorobenzene	Benzyl alcohol
4-Methylphenol	Biphenyl
Acetophenone	Carbazole
Benzaldehyde	Phenol
Benzoic acid	
VOCs	
1,2,4-Trimethylbenzene	Methyl isobutyl ketone
Benzene	Tetrachloroethene
Carbon disulfide	Toluene
cis-1,2-Dichloroethene	Trichloroethene
p-Cymene	o-Xylene
Dichloromethane	m,p-Xylene
Ethylbenzene	Total xylenes
Methyl ethyl ketone	
TPH	
TPH-gasoline range	TPH-motor oil range (HCID)
TPH-diesel range (HCID)	TPH-motor oil range
TPH-diesel range	Total petroleum hydrocarbons

COI – chemical of interest
NOAEL – no-observed-adverse-effect level
HCID – hydrocarbon identification
PAH – polycyclic aromatic hydrocarbon
SVOC – semivolatile organic compound
TPH – total petroleum hydrocarbons
TRV – toxicity reference value
VOC – volatile organic compound

Table 2-33 presents the results of the dietary COPC screen for red-tailed hawk. Two COPCs (i.e., aluminum and total DDTs) were identified. These COPCs are evaluated further in the wildlife risk assessment for this ROC (Section 5.3).

Table 2-33. Results of the Red-Tailed Hawk Dietary COPC Screen

Wetland Soil COI	Soil Concentration		BAF		Prey Tissue Concentration		Estimated Maximum Dose			COPC?
	C_{soil} [a]	Unit (dw)	Mammal BAF	Unit	C_{mammal} [b]	Unit (ww)	$Dose_{diet}$ [c]	NOAEL TRV	Unit	
Metals										
Aluminum	12,100	mg/kg	1	tiss dw/sed dw	3900	mg/kg	**390**	157	mg/kg bw/day	**yes**
Arsenic	53.1	mg/kg	0.0063	tiss dw/sed dw	0.11	mg/kg	0.028	10	mg/kg bw/day	no
Cadmium	4	mg/kg	1.9902	tiss dw/sed dw	2.5	mg/kg	0.25	1.5	mg/kg bw/day	no
Chromium	149	mg/kg	0.1382	tiss dw/sed dw	6.6	mg/kg	0.7	1	mg/kg bw/day	no
Cobalt	34.3	mg/kg	0.0371	tiss dw/sed dw	0.41	mg/kg	0.051	2.31	mg/kg bw/day	no
Copper	1,240	mg/kg	0.42	tiss dw/sed dw	170	mg/kg	17	21	mg/kg bw/day	no
Lead	320	mg/kg	0.1615	tiss dw/sed dw	17	mg/kg	1.8	5.82	mg/kg bw/day	no
Mercury	0.4	mg/kg	0.1244	tiss dw/sed dw	0.016	mg/kg	0.0017	0.018	mg/kg bw/day	no
Nickel	48	mg/kg	0.2799	tiss dw/sed dw	4.3	mg/kg	0.44	77	mg/kg bw/day	no
Selenium	1.1	mg/kg	0.3464	tiss dw/sed dw	0.12	mg/kg	0.012	0.5	mg/kg bw/day	no
Vanadium	148	mg/kg	0.0123	tiss dw/sed dw	0.58	mg/kg	0.10	1.2	mg/kg bw/day	no
Zinc	748	mg/kg	1.3352	tiss dw/sed dw	320	mg/kg	32	82	mg/kg bw/day	no
PAHs										
Benzo(a)pyrene	4,000	µg/kg	0.001	tiss dw/sed dw	1.3	µg/kg	1.4	280	µg/kg bw/day	no
Total PAHs	69,000	µg/kg	0.001	tiss dw/sed dw	22	µg/kg	24	8,000	µg/kg bw/day	no
Phthalates										
BEHP	9,100	µg/kg	1	tiss dw/sed dw	2,900	µg/kg	290	65,800	µg/kg bw/day	no
Butyl benzyl phthalate	3,140	µg/kg	1	tiss dw/sed dw	1,000	µg/kg	100	65,800	µg/kg bw/day	no
Di-n-butyl phthalate	2,400	µg/kg	1	tiss dw/sed dw	770	µg/kg	77	65,800	µg/kg bw/day	no
Other SVOCs										
Hexachlorobenzene	42	µg/kg	1	tiss dw/sed dw	13	µg/kg	1.3	1,100	µg/kg bw/day	no
Pentachlorophenol	80	µg/kg	1	tiss dw/sed dw	26	µg/kg	2.6	22,000	µg/kg bw/day	no
PCBs										
Total PCBs	4,200	µg/kg	0.45	tiss-ww/sed dw	1,900	µg/kg	190	490	µg/kg bw/day	no
Pesticides										
Total DDTs	46,000	µg/kg	C_{mammal} = ([C_{plant} x 0.75]+[C_{invert} x 0.25]) x 4.83 [d]	tiss dw/sed dw	200,000 [d]	µg/kg	**20,000**	64	µg/kg bw/day	**yes**
delta-BHC	3	µg/kg	0.157	tiss dw/sed dw	0.15	µg/kg	0.016	1,600	µg/kg bw/day	no

Table 2-33. Results of the Red-Tailed Hawk Dietary COPC Screen

Wetland Soil COI	Soil Concentration		BAF		Prey Tissue Concentration		Estimated Maximum Dose			COPC?
	C_{soil} [a]	Unit (dw)	Mammal BAF	Unit	C_{mammal} [b]	Unit (ww)	$Dose_{diet}$ [c]	NOAEL TRV	Unit	
Methoxychlor	4.6	µg/kg	1	tiss dw/sed dw	1.5	µg/kg	0.15	34,600	µg/kg bw/day	no
VOCs										
Acetone	2,300	µg/kg	1	tiss dw/sed dw	740	µg/kg	74	6,647,000	µg/kg bw/day	no

[a] C_{soil} is represented by maximum soil concentration.

[b] C_{mammal} was estimated from C_{soil} and a mammal BAF and converted to ww assuming percent moisture of 68%. C_{mammal} (ww) = [BAF(dw/dw) x Max_{soil}] x (1 – F_M), where F_M = fraction moisture. See Appendix B for details on selected BAFs and assumptions used to estimate prey tissue concentrations.

[c] $Dose_{diet}$ was calculated using Equation 3-5, exposure parameters presented in Table 3-9, and assumption that diet is composed of 100% terrestrial small mammals.

[d] C_{mammal} was calculated using BAF regression, where C_{plant} = 261 µg/kg dw and C_{invert} = 515,200 µg/kg dw.

BAF – bioaccumulation factor
BEHP – bis(2-ethylhexyl) phthalate
BHC – hexachlorocyclohexane
bw – body weight
COI – chemical of interest
COPC – chemical of potential concern
DDT – dichlorodiphenyltrichloroethane
dw – dry weight
NOAEL – no-observed-adverse-effect level
OC – organic carbon
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
SVOC – semivolatile organic compound
TRV – toxicity reference value
VOC – volatile organic compound
ww – wet weight

BOLD identifies COPCs.

2.6.6 Terrestrial Mammals

This section presents the COPC screen, which is summarized in Figure 2-9 for the terrestrial mammal ROCs (Eastern cottontail and shrew).

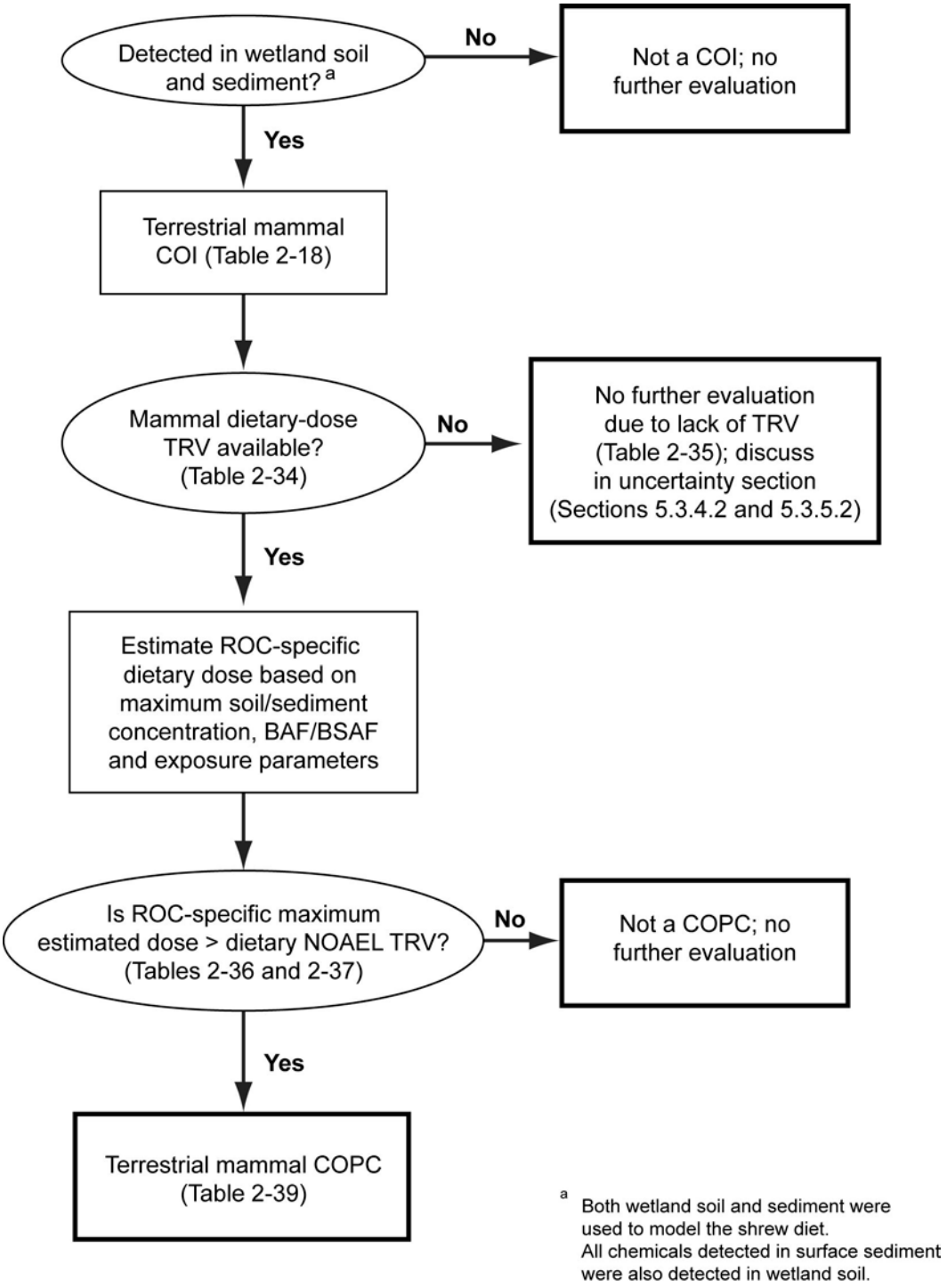

Figure 2-9. COPC Screening Process for Terrestrial Mammal ROCs

2.6.6.1 COIs for Terrestrial Mammals

The first step in the COPC screen for terrestrial mammals was the identification of COIs. COIs were defined as any analyte detected in wetland soil[4] (see Table 2-18).

2.6.6.2 COPC Screen for Terrestrial Mammals

In the next step to identify COPCs for terrestrial mammal ROCs, maximum detected COI concentrations in sediment and soil[5] and maximum estimated COI concentrations in potential prey items were used to estimate a ROC-specific maximum dietary dose (see method described in Section 4.1). COI concentrations in prey were estimated using BSAFs and BAFs and assumptions presented in Appendix B. These concentrations were converted to dietary doses using the approach outlined in Section 3.2.2. Maximum dietary doses were then compared to dietary-dose NOAEL TRVs for mammals; COIs with maximum doses that were greater than the TRVs were identified as COPCs for the ROC.

NOAEL TRVs were identified using the process presented in Section 2.6.3.2, with one exception: allometric equations based on laboratory data were used to estimate the ingestion rate for mammals (EPA 1988).

Selected NOAEL TRVs for mammals are presented in Table 2-34. Individual PAH COIs (other than benzo[a]pyrene, naphthalene, and 2-methylnaphthalene) were evaluated using TRVs for benzo(a)pyrene and total PAHs. Individual DDT metabolite and PCB Aroclor COIs were evaluated using TRVs for total DDTs and total PCBs, respectively. The COIs for which no mammal dietary-dose TRV could be developed are presented in Table 2-35; these COIs are noted in the uncertainty analysis.

Table 2-34. Selected Dietary-Dose NOAEL TRVs for the Terrestrial Mammal COPC Screen

Wetland Soil COI	Test Species	NOAEL (mg/kg bw/day)	Endpoint	Source
Metals				
Aluminum	mouse	34.3	reproduction, growth	Ondreicka et al. (1966)
Antimony	rat	1,489	growth, survival	Hext et al. (1999)
Arsenic	rat	2.6	growth	Byron et al. (1967)
Cadmium	rat	3.5	growth	Machemer and Lorke (1981)
Chromium	rat	1,466	growth, survival	Ivankovic and Preussman (1975)
Cobalt	rat	0.1[a]	growth	Chetty et al. (1979)
Copper	mink	18	reproduction	Aulerich et al. (1982)
Lead	rat	11	growth	Azar et al. (1973)
Mercury	rat	0.0017[b]	growth	Verschuuren et al. (1976)
Nickel	rat	na	reproduction	Ambrose et al. (1976)

[4] Both wetland soil and sediment were used to model the shrew diet, which consists of both terrestrial and aquatic prey. All chemicals detected in sediment (Table 2-11) were also detected in soil (Table 2-18).
[5] Both wetland soil and sediment were used to model the shrew diet, which consists of both terrestrial and aquatic prey.

Table 2-34. Selected Dietary-Dose NOAEL TRVs for the Terrestrial Mammal COPC Screen

Wetland Soil COI	Test Species	NOAEL (mg/kg bw/day)	Endpoint	Source
	rat	8.4	growth	
Selenium	rat	0.055	growth	Halverson et al. (1966)
Vanadium	rat	0.27[a]	growth	Adachi et al. (2000)
Zinc	rat	160	reproduction	Schlicker and Cox (1968)
PAHs				
2-Methylnaphthalene	mouse	54	growth	Murata et al. (1997)
Benzo(a)pyrene	mouse	2.0[b]	reproduction	MacKenzie and Angevine (1981)
Naphthalene	mouse	133	growth, survival	Shopp et al. (1984)
Total PAHs[c]	mouse	2.0[b]	reproduction	benzo(a)pyrene TRVs
Phthalates				
BEHP	mouse	44	reproduction	Tyl et al. (1988)
Butyl benzyl phthalate	rat	250	growth, reproduction	Tyl et al. (2004)
Di-n-butyl phthalate	rat	16[b]	reproduction	Wine et al. (1997)
Other SVOCs				
Benzoic acid	rat	80	growth, survival	Ignat'ev (1965), as cited in IRIS (EPA 2006)
Biphenyl	rat	50	survival	Ambrose et al. (1960), as cited in IRIS (EPA 2006)
Hexachlorobenzene	mink and ferret	0.026[b]	reproduction	Bleavins et al. (1984)
Phenol	rat	60	growth	Argus Research Laboratories (1997), as cited in IRIS (EPA 2006)[d]
	rat	60	reproduction	Charles River Laboratories (1988) and NTP (1983), as cited in IRIS (EPA 2006)[d]
PCBs				
Total PCBs[e]	mink	0.045[f]	reproduction	Brunstrom et al. (2001)
Pesticides				
delta-BHC[g]	rat	5.7[g]	growth, survival	Van Velsen et al. (1986)
Total DDTs[h]	rat	1.2	reproduction	Duby et al. (1971)
Methoxychlor	rat	17	growth, reproduction	Masutomi et al. (2003)
VOCs				
Acetone	rat	1,650	growth	Dietz et al. (1991)
Ethylbenzene	rat	250	growth	Mellert et al. (2007)

[a] NOAEL was estimated from an acute or subchronic LOAEL using a UF of 10.

[b] NOAEL was estimated from an chronic LOAEL using a UF of 5.

[c] Individual PAH COIs listed in Table 2-18 (acenaphthylene, acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, total benzofluoranthenes [benzo(b)fluoranthene and benzo(k)fluoranthene], benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, indeno(1,2,3,-c,d)pyrene, fluoranthene, fluorene, naphthalene, phenanthrene, and pyrene) were evaluated as part of the total PAH sum.

[d] Both studies had the same LOAEL and NOAEL.

[e] Individual PCB Aroclor COIs listed in Table 2-18 (Aroclor 1248, Aroclor 1254, and Aroclor 1260) were evaluated as part of the total PCB sum.

[f] NOAEL was estimated from a chronic LOAEL using a UF of 2; the rationale for using this UF is discussed in Section 4.4.

[g] TRVs for delta-BHC are based on TRVs reported for beta-BHC.

[h] Individual DDT metabolite COIs listed in Table 2-18 (2,4′-DDD, 2,4′-DDE, 2,4′-DDT, 4,4′-DDD, 4,4′-DDE, and 4,4′-DDT,) were evaluated as part of the total DDT sum.

BEHP – bis(2-ethylhexyl) phthalate
BHC – hexachlorocyclohexane
bw – body weight
COI – chemical of interest
COPC – chemical of potential concern
DDT – dichlorodiphenyltrichloroethane
IRIS – Integrated Risk Information System
LOAEL – lowest-observed-adverse-effect level
na – not available
NOAEL – no-observed-adverse-effect level
ns – not selected (NOAEL or LOAEL was not selected from this study)
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
SVOC – semivolatile organic compound
TRV – toxicity reference value
UF – uncertainty factor
VOC – volatile organic compound

Table 2-35. COIs without Mammal NOAEL TRVs

Wetland Soil COI	
Metals	
Barium	Manganese
Beryllium	Silver
PAHs	
Dibenzofuran	
Other SVOCs	
1,4-Dichlorobenzene	Benzyl alcohol
4-Methylphenol	Carbazole
Acetophenone	Pentachlorophenol
Benzaldehyde	
VOCs	
1,2,4-Trimethylbenzene	Methyl isobutyl ketone
Benzene	Tetrachloroethene
Carbon disulfide	Toluene
cis-1,2-Dichloroethene	Trichloroethene
p-Cymene	o-Xylene
Dichloromethane	m,p-Xylene
Methyl ethyl ketone	Total xylenes
TPH	
TPH-gasoline range	TPH-motor oil range (HCID)
TPH-diesel range (HCID)	TPH-motor oil range
TPH-diesel range	Total petroleum hydrocarbons

COI – chemical of interest
HCID – hydrocarbon identification
PAH – polycyclic aromatic hydrocarbon
SVOC – semivolatile organic compound
TPH – total petroleum hydrocarbons
VOC – volatile organic compound

Tables 2-36 and 2-37 present the results of the COPC screen for Eastern cottontail and shrew. Seven COPCs (i.e., aluminum, cobalt, copper, mercury,

selenium, vanadium, and total PAHs) were identified for Eastern cottontail and fourteen COPCs (i.e., aluminum, arsenic, cadmium, cobalt, copper, lead, mercury, nickel, selenium, vanadium, zinc, total PAHs, total PCBs, and total DDTs) were identified for shrew. These COPCs are evaluated further in the wildlife risk assessment for these ROCs (Section 5.3).

Table 2-36. Results of the Eastern Cottontail Dietary COPC Screen

Wetland Soil COI	Soil Concentration		BAF		Prey Tissue Concentration		Estimated Maximum Dose			COPC?
	C_{soil} [a]	Unit (dw)	Plant BAF	Unit	C_{plant} [b]	Unit (ww)	$Dose_{diet}$ [c]	NOAEL TRV	Unit	
Metals										
Aluminum	12,100	mg/kg	1	tiss dw/sed dw	2,500	mg/kg	**530**	34.3	mg/kg bw/day	**yes**
Antimony	8.4	mg/kg	$C_{plant} = e^{(0.938*LN(Csoil)-3.233)}$	tiss dw/sed dw	0.061	mg/kg	0.034	1,489	mg/kg bw/day	no
Arsenic	53.1	mg/kg	0.454	tiss dw/sed dw	5.1	mg/kg	1.1	2.6	mg/kg bw/day	no
Cadmium	4	mg/kg	1.359	tiss dw/sed dw	1.1	mg/kg	0.23	3.5	mg/kg bw/day	no
Chromium	149	mg/kg	0.041	tiss dw/sed dw	1.3	mg/kg	0.65	1466	mg/kg bw/day	no
Cobalt	34.3	mg/kg	0.0075	tiss dw/sed dw	0.054	mg/kg	**0.10**	0.1	mg/kg bw/day	**yes**
Copper	1,240	mg/kg	0.341	tiss dw/sed dw	89	mg/kg	**21**	18	mg/kg bw/day	**yes**
Lead	320	mg/kg	0.245	tiss dw/sed dw	16	mg/kg	4.0	11	mg/kg bw/day	no
Mercury	0.4	mg/kg	1.481	tiss dw/sed dw	0.12	mg/kg	**0.025**	0.0017	mg/kg bw/day	**yes**
Nickel	48	mg/kg	0.749	tiss dw/sed dw	7.5	mg/kg	1.6	8.4	mg/kg bw/day	no
Selenium	1.1	mg/kg	2.253	tiss dw/sed dw	0.52	mg/kg	**0.11**	0.055	mg/kg bw/day	**yes**
Vanadium	148	mg/kg	0.00485	tiss dw/sed dw	0.15	mg/kg	0.42	0.27	mg/kg bw/day	**yes**
Zinc	748	mg/kg	1.021	tiss dw/sed dw	160	mg/kg	34	160	mg/kg bw/day	no
PAHs										
2-Methylnaphthalene	2,880	mg/kg	12.2	tiss dw/sed dw	7,400	µg/kg	1,500	54,000	µg/kg bw/day	no
Benzo(a)pyrene	4,000	mg/kg	$C_{plant} = e^{(0.975*LN(Csoil)-2.0615)}$	tiss dw/sed dw	87	µg/kg	28	2,000	µg/kg bw/day	no
Naphthalene	4,210	mg/kg	12.2	tiss dw/sed dw	11,000	µg/kg	2,200	133,000	µg/kg bw/day	no
Total PAHs	69,000	mg/kg	6.15	tiss dw/sed dw	89,000	µg/kg	**18,000**	2,000	µg/kg bw/day	**yes**
Phthalates										
BEHP	9,100	µg/kg	0.00179	tiss dw/sed dw	3.4	µg/kg	24	44,000	µg/kg bw/day	no
Butyl benzyl phthalate	3,140	µg/kg	0.00179	tiss dw/sed dw	1.2	µg/kg	8.4	250,000	µg/kg bw/day	no
Di-n-butyl phthalate	2,400	µg/kg	0.128	tiss dw/sed dw	65	µg/kg	19	16,000	µg/kg bw/day	no
Other SVOCs										
Benzoic acid	28,000	µg/kg	1	tiss dw/sed dw	5,900	µg/kg	1,200	80,000	µg/kg bw/day	no

Table 2-36. Results of the Eastern Cottontail Dietary COPC Screen

Wetland Soil COI	Soil Concentration		BAF		Prey Tissue Concentration		Estimated Maximum Dose			COPC?
	C_{soil} [a]	Unit (dw)	Plant BAF	Unit	C_{plant} [b]	Unit (ww)	$Dose_{diet}$ [c]	NOAEL TRV	Unit	
Biphenyl	836	µg/kg	1	tiss dw/sed dw	180	µg/kg	38	50,000	µg/kg bw/day	no
Hexachlorobenzene	42	µg/kg	0.0189	tiss dw/sed dw	0.17	µg/kg	0.14	26	µg/kg bw/day	no
Phenol	498	µg/kg	5.55	tiss dw/sed dw	580	µg/kg	120	60,000	µg/kg bw/day	no
PCBs										
Total PCBs	4,200	µg/kg	0.00519	tiss dw/sed dw	4.6	µg/kg	12	45	µg/kg bw/day	no
Pesticides										
Total DDTs	46,000	µg/kg	$C_{plant} = e^{(0.7524*LN(Csoil)-2.5119)}$	tiss dw/sed dw	55	µg/kg	130	1,200	µg/kg bw/day	no
delta-BHC	3	µg/kg	0.157	tiss dw/sed dw	0.099	µg/kg	0.027	5,700	µg/kg bw/day	no
Methoxychlor	4.6	µg/kg	0.0585	tiss dw/sed dw	0.057	µg/kg	0.023	17,000	µg/kg bw/day	no
VOCs										
Acetone	2,300	µg/kg	53.3	tiss dw/sed dw	26,000	µg/kg	5,100	1,650,000	µg/kg bw/day	no
Ethylbenzene	3.4	µg/kg	0.348	tiss dw/sed dw	0.25	µg/kg	0.058	250,000	µg/kg bw/day	no

[a] C_{soil} is represented by maximum soil concentration.

[b] C_{plant} was estimated from C_{soil} and a plant BAF and converted to ww assuming percent moisture of 79%. C_{plant} (ww) = [BAF(dw/dw) x Max_{soil}] x (1 – F_M), where F_M = fraction moisture. See Appendix B for details on selected BAFs and assumptions used to estimate prey tissue concentrations.

[c] $Dose_{diet}$ was calculated using Equation 3-5, exposure parameters presented in Table 3-9, and assumption that diet is composed of 100% terrestrial plants.

BAF – bioaccumulation factor
BEHP – bis(2-ethylhexyl) phthalate
BHC – hexachlorocyclohexane
bw – body weight
COI – chemical of interest
COPC – chemical of potential concern
DDT – dichlorodiphenyltrichloroethane
dw – dry weight
LN – natural logarithm
NOAEL – no-observed-adverse-effect level
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
SVOC – semivolatile organic compound
TRV – toxicity reference value
VOC – volatile organic compound
ww – wet weight

BOLD identifies COPCs.

Table 2-37. Results of the Shrew Dietary COPC Screen

Wetland Soil COI	Soil Concentration		Sediment Concentration		BSAF		BAF		Prey Tissue Concentration			Estimated Maximum Dose			COPC?
	C_{soil} [a]	Unit	C_{sed} [b]	Unit	Aquatic Invert BSAF	Unit	Invert BAF	Unit	$C_{aquat\ invert}$ [c]	C_{invert} [d]	Unit	$Dose_{diet}$ [e]	NOAEL TRV	Unit	
Metals															
Aluminum	12,100	mg/kg dw	na[f]	na	1	tiss dw/sed dw	1	tiss dw/ sed dw	na	3,500	mg/kg ww	**2,200**[g]	34.3	mg/kg bw/day	**yes**
Antimony	8.4	mg/kg dw	1[h]	mg/kg dw	1	tiss dw/ sed dw	1	tiss dw/ sed dw	0.21	2.4	mg/kg ww	1.2	1,489	mg/kg bw/day	no
Arsenic	53.1	mg/kg dw	7	mg/kg dw	0.24	tiss dw/ sed dw	0.258	tiss dw/ sed dw	0.35	4.0	mg/kg ww	**2.7**	2.6	mg/kg bw/day	**yes**
Cadmium	4	mg/kg dw	2	mg/kg dw	3.438	tiss dw/ sed dw	17.105	tiss dw/ sed dw	1.4	20	mg/kg ww	**8.2**	3.5	mg/kg bw/day	**yes**
Chromium	149	mg/kg dw	34	mg/kg dw	0.206	tiss dw/ sed dw	1.099	tiss dw/ sed dw	1.5	47	mg/kg ww	22	1,466	mg/kg bw/day	no
Cobalt	34.3	mg/kg dw	15	mg/kg dw	1	tiss dw/ sed dw	0.122	tiss dw/ sed dw	3.2	1.2	mg/kg ww	**1.7**	0.1	mg/kg bw/day	**yes**
Copper	1,240	mg/kg dw	72	mg/kg dw	2.14	tiss dw/ sed dw	0.754	tiss dw/ sed dw	32	270	mg/kg ww	**140**	18	mg/kg bw/day	**yes**
Lead	320	mg/kg dw	56	mg/kg dw	0.331	tiss dw/ sed dw	3.342	tiss dw/ sed dw	3.9	310	mg/kg ww	**130**	11	mg/kg bw/day	**yes**
Mercury	0.4	mg/kg dw	0.2	mg/kg dw	1.204	tiss dw/ sed dw	5.231	tiss dw/ sed dw	0.051	0.61	mg/kg ww	**0.26**	0.0017	mg/kg bw/day	**yes**
Nickel	48	mg/kg dw	31	mg/kg dw	1.313	tiss dw/ sed dw	1.656	tiss dw/ sed dw	8.5	23	mg/kg ww	**11**	8.4	mg/kg bw/day	**yes**
Selenium	1.1	mg/kg dw	4[h]	mg/kg dw	1	tiss dw/ sed dw	1.798	tiss dw/ sed dw	0.84	0.57	mg/kg ww	**0.39**	0.055	mg/kg bw/day	**yes**
Vanadium	148	mg/kg dw	74	mg/kg dw	1	tiss dw/ sed dw	0.042	tiss dw/ sed dw	16	1.8	mg/kg ww	**6.5**	0.27	mg/kg bw/day	**yes**
Zinc	748	mg/kg dw	229	mg/kg dw	3.473	tiss dw/ sed dw	5.766	tiss dw/ sed dw	170	1,300	mg/kg ww	**550**	160	mg/kg bw/day	**yes**
PAHs															
2-Methylnaphthalene	2,880	µg/kg dw	0.61	mg/kg OC	3.19	tiss lipid/ sed OC	4.4	tiss dw/ sed dw	23	3,700	µg/kg ww	1,500	54,000	µg/kg bw/day	no
Benzo(a)pyrene	4,000	µg/kg dw	1.3	mg/kg OC	0.383	tiss lipid/ sed OC	1.33	tiss dw/ sed dw	6.0	1,500	µg/kg ww	670	2,000	µg/kg bw/day	no

Table 2-37. Results of the Shrew Dietary COPC Screen

Wetland Soil COI	Soil Concentration		Sediment Concentration		BSAF		BAF		Prey Tissue Concentration			Estimated Maximum Dose			COPC?
	C_{soil} [a]	Unit	C_{sed} [b]	Unit	Aquatic Invert BSAF	Unit	Invert BAF	Unit	$C_{aquat\ invert}$ [c]	C_{invert} [d]	Unit	$Dose_{diet}$ [e]	NOAEL TRV	Unit	
Naphthalene	4,210	µg/kg dw	1.2	mg/kg OC	0.588	tiss lipid/ sed OC	4.4	tiss dw/ sed dw	8.5	5400	µg/kg ww	2,200	133,000	µg/kg bw/day	no
Total PAHs	69,000	µg/kg dw	19.8	mg/kg OC	0.923	tiss lipid/ sed OC	2.87	tiss dw/ sed dw	220	57,000	µg/kg ww	**24,000**	2,000	µg/kg bw/day	**yes**
Phthalates															
BEHP	9,100	µg/kg dw	na[f]	na	48.5	na	1	tiss dw/ sed dw	na	2,600	µg/kg ww	1,600[g]	44,000	µg/kg bw/day	no
Butyl benzyl phthalate	3,140	µg/kg dw	na[f]	na	48.5	na	1	tiss dw/ sed dw	na	910	µg/kg ww	580[g]	250,000	µg/kg bw/day	no
Di-n-butyl phthalate	2,400	µg/kg dw	na[f]	na	48.5	na	1	tiss dw/ sed dw	na	700	µg/kg ww	440[g]	16,000	µg/kg bw/day	no
Other SVOCs															
Benzoic acid	28,000	µg/kg dw	na[f]	na	na	na	1	tiss dw/ sed dw	na	8,100	µg/kg ww	5,100[g]	80,000	µg/kg bw/day	no
Biphenyl	836	µg/kg dw	na[f]	na	na	na	1	tiss dw/ sed dw	na	240	µg/kg ww	150[g]	50,000	µg/kg bw/day	no
Hexachlorobenzene	42	µg/kg dw	0.17[h,i]	mg/kg OC	1	tiss lipid/ sed OC	1	tiss dw/ sed dw	2.0	12	µg/kg ww	5.9	26	µg/kg bw/day	no
Phenol	498	µg/kg dw	na[f]	na	1	na	1	tiss dw/ sed dw	na	140	µg/kg ww	89[g]	60,000	µg/kg bw/day	no
PCBs															
Total PCBs	4,200	µg/kg dw	1.83	mg/kg OC	2.57	tiss lipid/ sed OC	8.91	tiss dw/ sed dw	56	11,000	µg/kg ww	**4,400**	45	µg/kg bw/day	**yes**
Pesticides															
Total DDTs	46,000	µg/kg dw	3.7	mg/kg OC	4.52	tiss lipid/ sed OC	11.2	tiss dw/ sed dw	200	150,000	µg/kg ww	**60,000**	1,200	µg/kg bw/day	**yes**
delta-BHC	3	µg/kg dw	0.17[h,i]	mg/kg OC	1	tiss lipid/ sed OC	1	tiss dw/ sed dw	2.0	0.87	µg/kg ww	0.74	5,700	µg/kg bw/day	no

Table 2-37. Results of the Shrew Dietary COPC Screen

Wetland Soil COI	Soil Concentration		Sediment Concentration		BSAF		BAF		Prey Tissue Concentration			Estimated Maximum Dose			COPC?
	C_{soil} [a]	Unit	C_{sed} [b]	Unit	Aquatic Invert BSAF	Unit	Invert BAF	Unit	$C_{aquatic\ invert}$ [c]	C_{invert} [d]	Unit	$Dose_{diet}$ [e]	NOAEL TRV	Unit	
Methoxychlor	4.6	µg/kg dw	1.7[h,i]	mg/kg OC	1	tiss lipid/ sed OC	1	tiss dw/ sed dw	20	1.3	µg/kg ww	4.0	17,000	µg/kg bw/day	no
VOCs															
Acetone	2,300	µg/kg dw	14	mg/kg OC	1	tiss lipid/ sed OC	1	tiss dw/ sed dw	170	370	µg/kg ww	341	1,650,000	µg/kg bw/day	no
Ethylbenzene	3.4	µg/kg dw	0.12[h,i]	mg/kg OC	1	tiss lipid/ sed OC	1	tiss dw/ sed dw	1.4	0.99	µg/kg ww	0.70	250,000	µg/kg bw/day	no

[a] C_{soil} is represented by maximum soil concentration.

[b] C_{sed} is represented by maximum sediment concentration.

[c] $C_{aquatic\ invert}$ was estimated from C_{sed} (either as a dw concentration or an OC-normalized concentration) and an aquatic benthic invertebrate BSAF. When the sediment concentration was dw, the following equation was used: $C_{aquatic\ invert}$ (ww) = (BSAF x Max_{sed}) x (1 – F_M), where F_M = fraction moisture. When the sediment concentration was OC-normalized, the following equation was used: $C_{aquatic\ invert}$ (ww) = (BSAF x Max_{sed}) x F_L, where F_L = fraction lipid. $C_{aquatic\ invert}$ was converted to ww assuming a moisture content of 79% or a lipid content of 1.2%. See Appendix B for details on selected BSAFs and assumptions used to estimate prey tissue concentrations.

[d] C_{invert} was estimated from C_{soil} and an invertebrate BAF and converted to ww assuming a moisture content of 71%. C_{invert} (ww) = [BAF(dw/dw) x Max_{soil}] x (1 – F_M), where F_M = fraction moisture. See Appendix B for details on selected BAFs and assumptions used to estimate prey tissue concentrations.

[e] $Dose_{diet}$ was calculated using Equations 3-1 and 3-5, exposure parameters presented in Table 3-9, and assumption that diet is composed of 70% (30% earthworms and 40% terrestrial invertebrates) and 30% aquatic invertebrates.

[f] Chemical was not analyzed in sediment.

[g] $Dose_{diet}$ estimated assuming 100% terrestrial prey (because no sediment data available to model aquatic prey).

[h] C_{sed} is represented by maximum RL (chemical not detected in sediment).

[i] Maximum RL was converted into mg/kg OC using the average sediment OC measured in Force Lake (7.1%).

BAF – bioaccumulation factor
BEHP – bis(2-ethylhexyl) phthalate
BHC – hexachlorocyclohexane
BSAF – biota-sediment accumulation factor
bw – body weight
COI – chemical of interest
COPC – chemical of potential concern
DDT – dichlorodiphenyltrichloroethane
dw – dry weight
na – not available
NOAEL – no observed adverse effect level
OC – organic carbon
PAH – polycyclic aromatic hydrocarbon \
PCB – polychlorinated biphenyl
SVOC – semivolatile organic compound
TRV – toxicity reference value
VOC – volatile organic compound
ww – wet weight

BOLD identifies COPCs.

2.6.5 Summary of COPCs

Table 2-38 presents all COPCs for aquatic benthic and terrestrial invertebrates. Table 2-39 identifies the ROC-COPC pairs for all fish and wildlife COPCs.

Table 2-38. Summary of Invertebrate COPCs

COPC	Aquatic Benthic Invertebrate COPC[a]	Terrestrial Invertebrate COPC[b]
Metals		
Aluminum		X
Arsenic	X	
Barium	X	X
Cadmium	X	
Chromium		X
Cobalt		
Copper	X	X
Lead	X	
Manganese		X
Mercury	X	X
Nickel	X	
Selenium		
Vanadium		
Zinc	X	X
PAHs		
Benzo(a)anthracene	X	
Benzo(a)pyrene	X	
Chrysene	X	
Fluoranthene	X	
Phenanthrene	X	
Pyrene	X	
Total HPAHs		X
Total PAHs		
PCBs		
Total PCBs	X	
Pesticides		
2,4′-DDD	X	
4,4′-DDD	X	
4,4′-DDE	X	
Total DDTs	X	

[a] Aquatic benthic invertebrate COPCs based on screening of sediment and surface water as presented in Tables 2-15 and 2-17, respectively.

[b] Terrestrial invertebrate COPCs based on screening of soils as presented in Table 2-21.

COPC – chemical of potential concern
DDD – dichlorodiphenyldichloroethane
DDE – dichlorodiphenyldichloroethylene
DDT – dichlorodiphenyltrichloroethane
HPAH – high-molecular-weight polycyclic aromatic hydrocarbon
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl

Table 2-39. Summary of Fish and Wildlife ROC-COPC Pairs

	Aquatic ROCs				Terrestrial ROCs		
COPC	**Pumpkin-seed[a]**	**Brown Bullhead[b]**	**Ruddy Duck[c]**	**Great Blue Heron[d]**	**Red-Tailed Hawk[e]**	**Eastern Cotton-tail[f]**	**Shrew[g]**
Metals							
Aluminum					X	X	X
Arsenic							X
Barium	X	X					
Cadmium	X	X					X
Cobalt						X	X
Copper	X	X				X	X
Lead							X
Mercury			X			X	X
Nickel							X
Selenium						X	X
Vanadium	X	X	X	X		X	X
Zinc							X
PAHs							
Total PAHs						X	X
PCBs							
Total PCBs	X	X					X
Pesticides							
Total DDTs			X	X	X		X

[a] COPCs based on screening of surface water, fish tissue, and ROC-specific diet, as presented in Tables 2-17,2-23, and 2-25, respectively.
[b] COPCs based on screening of surface water, fish tissue, and ROC-specific diet, as presented in Tables 2-17,2-23, and 2-26, respectively.
[c] COPCs based on screening of ROC-specific diet, as presented in Table 2-29.
[d] COPCs based on screening of ROC-specific diet, as presented in Table 2-30.
[e] COPCs based on screening of ROC-specific diet, as presented in Table 2-33.
[f] COPCs based on screening of ROC-specific diet, as presented in Table 2-36.
[g] COPCs based on screening of ROC-specific diet, as presented in Table 2-37.

COPC – chemical of potential concern
DDT – dichlorodiphenyltrichloroethane
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
ROC – receptor of concern

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